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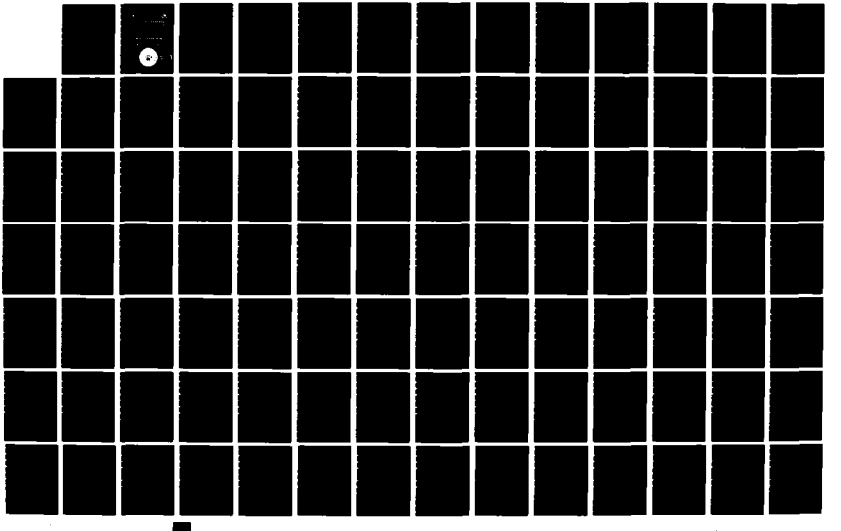

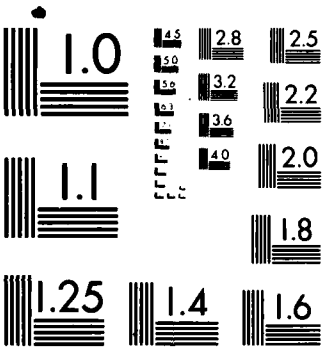

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NAVY EXPERIMENTAL DIVING UNIT

REPORT NO. 9-85

REPETITIVE/MULTI-LEVEL DIVE PROCEDURES AND TABLES FOR CONSTANT 0.7 ATA OXYGEN PARTIAL PRESSURE IN NITROGEN DIVING

By:

Edward D. Thalmann, CDR, MC, USN

September 1985

NAVY EXPERIMENTAL DIVING UNIT

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DEPARTMENT OF THE NAVY
NAVY EXPERIMENTAL DIVING UNIT
PANAMA CITY, FLORIDA 32407

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Approved for public release; distribution unlimited.

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DECOMPRESSION TABLES	UDC
REPETITIVE DIVING	UNDERWATER DECOMPRESSION COMPUTER
MULTI-LEVEL DIVING	CONSTANT PARTIAL PRESSURE DECOMPRESSION COMPUTER

20 ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

A tabular method for computing decompression schedules for a constant 0.7 ATA PO_2 in N_2 breathing medium is presented. The main body of the report discusses the theory and limitations of the procedure. The Appendix of the report presents all necessary tables for carrying out the procedure as well as a detailed set of instructions and numerous examples. The procedures presented are compatible with current U.S. Navy Standard Air Decompression

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FIGURES

ABSTRACT

A tabular method for computing decompression schedules for a constant 0.7 ATA PO_2 in N_2 breathing medium is presented. The main body of the report discusses the theory and limitations of the procedure. The Appendix of the report presents all necessary tables for carrying out the procedure as well as a detailed set of instructions and numerous examples. The procedures presented are compatible with current U.S. Navy Standard Air Decompression Tables in that they allow air diving to precede or follow diving from the presented tables. The procedures and tables contained in the report are meant to serve as a basis upon which to develop operational procedures.

KEY WORDS:

Constant Partial Pressure
Decompression Computer
Decompression Model
Decompression Procedures
Decompression Tables
Multi-Level Diving
Repetitive Diving
UDC
Underwater Decompression Computer

GLOSSARY

Bottom Time - The time from beginning descent to a particular depth to the end of the stay at that depth.

Bounce Dive - A dive beginning after all tissues are saturated at the surface with descent to a given depth then ascent to the surface (taking any required decompression) after a specified bottom time.

Clean Dive - A dive with a shallow interval at 0 FSW or 10 FSW (3 MSW) long enough such that it has no effect on a subsequent dive.

Clean Time - The surface interval time at 0 FSW or 10 FSW (3 MSW) required for complete offgassing of the 120 min halftime tissue.

Control Depth - The deepest depth ever attained during a multi-level dive. The control depth cannot decrease unless a shallow interval is taken.

Current Depth - The actual depth of the diver during a given dive segment. This depth may or may not be at the control depth.

Dive Segment - A portion of a dive at the same depth. Each time a depth change occurs, a new dive segment occurs.

EL-MK 15/16 Real Time Algorithm (RTA) - A computer program using the EL-MK 15/16 Decompression Model which will compute and update a divers decompression obligation in real time. This refers to the Exponential-Linear version of the MK 15/16 RTA using the VVAL18 MPTT Table. (See ref. 2 for details).

Equivalent Dive - A depth/bottom time combination with the same Reference Tissue Tension (120 min tissue in this report) just before beginning decompression as a previous depth/bottom time combination. Letter groups are used to select equivalent dives after all decompression had been completed on a previous dive and number groups are used for multiple-level diving where all decompression has not been completed.

MPTT - Maximum Permissible Tissue Tension. The maximum tension which can be present in any tissue at a given depth such that decompression sickness will not occur. (See ref. 2 for complete description).

Multi-Level Dive- A dive consisting of at least two dive segments where there is no shallow interval or if there is one it is too short to allow a decrease in control depth.

Repetitive Dive - A dive following a shallow interval long enough to allow a decrease in control depth.

Residual Nitrogen Time (RNT) - The time added to the bottom time at a given depth to compensate for inert gas dissolved in the body from a previous dive. In this report, RNT is the same as the Starting Time in the Multi-Level/Repetitive Dive Worksheet (Table A-8).

Shallow Interval-A period of time spent at a depth 30 FSW (9 MSW) or shallower.

Surface Interval- A shallow interval taken at the surface (1 ATA, 0 FSW).

Repetitive/Multi-Level Dive Procedures and Tables for Constant 0.7 ATA Oxygen Partial Pressure in Nitrogen Diving

by: Edward D. Thalmann, CDR, MC, USN

INTRODUCTION

The U.S. Navy Experimental Diving Unit (NEDU) has previously developed and tested a computer algorithm for computing real time decompression schedules for a constant 0.7 ATA PO_2 in N_2 breathing medium. (1,2). This algorithm was developed primarily for use with the MK 15 (3,4) or MK 16 (5) closed circuit underwater breathing apparatus (UBA), but can be used with any closed circuit UBA which uses a nitrogen or nitrogen-oxygen diluent and which maintains the inspired oxygen tension at 0.7 ATA or greater. (2). The computer algorithm which resulted from manned testing is known as the EL-MK 15/16 Real Time Algorithm (EL-MK 15/16 RTA) and is intended to be programmed into a small portable underwater decompression computer (UDC) which is carried by the diver and which updates the decompression profile in real time every 2 seconds. The same decompression model used to develop the EL-MK 15/16 RTA was also used to compute a set of decompression tables for use when a UDC is unavailable. (2). Both the EL-MK 15/16 RTA and the resultant decompression tables are already in Fleet use.

During development of the EL-MK 15/16 RTA, multiple level and repetitive dive profiles were tested. (2). A repetitive dive is a dive where a period of time is spent at some shallow depth so that offgassing occurs between successive downward excursions. A multiple level dive is a dive where a change in depth occurs without any intervening period of offgassing. The algorithm which resulted from this testing was the EL-MK 15/16 RTA using the VVAL18 MPTT Table (ref. 2) and can be used for a dive of any complexity within certain depth/time restraints. The exact nature of these restraints is described elsewhere (2) but the maximum depth/time profile which was tested was 150 FSW for 30 min. When the decompression tables computed using the same decompression model as used in developing the EL-MK 15/16 RTA were originally published, only bounce dive schedules were published (2). There has now arisen a need for a set of repetitive dive tables for use during training exercises and other instances where a UDC is not available. This report describes the assumptions used in developing these repetitive dive tables and also presents a full set of tables with instructions for their use. Besides repetitive diving the tables described in this report are designed to allow for multiple level diving and are compatible with current U.S. Navy Standard Air Decompression Table repetitive diving procedures.

At the outset, it must be stressed that it is not the intent of this report to present a set of tables or procedures which would be used as is by the Fleet. Rather, the most comprehensive and flexible procedures which could be developed using a tabular method will be presented along with the theory used in developing them. It will be up to Fleet operators to decide whether all or only part of the presented procedures will be used. It is probable that not all possible problems or inconsistencies in using the procedures presented in this report have been uncovered. If some problems do arise during use, the information contained in this report should be comprehensive enough to allow modification of procedures, or institution of new rules to

take care of them. This report is intended to serve as the basis for developing a set of comprehensive and easily usable operational procedures for Fleet use. The final table format and methods of presentation of instructions and examples should be developed based on the ability of Fleet operators to easily understand and use them.

METHODS

Since the original EL-MK 15/16 RTA testing involved multiple level and repetitive diving, no new man testing was done in developing the Repetitive/ Multi-Level Dive Tables presented here. Rather a tabular method was developed which is mathematically consistent with the EL-MK 15/16 RTA and which will predict decompression profiles equal to or longer than real time calculation for a given dive profile. In order to keep the resultant tables relatively simple, some compromises had to be made which usually result in more conservative decompression tables when compared to real time calculation.

The EL-MK 15/16 RTA keeps track of inert gas tensions in 9 theoretical halftime tissues and updates them every two seconds given the ambient pressure. It may be possible to develop a tabular method of keeping track of all 9 tissue tensions but this would be extremely complex and involve several tens of pages of tables. The method used in this report is similar to that used in developing the repetitive dive air tables (6) and involves keeping track of the tensions in only a single tissue, called the reference tissue, with the halftime denoted by T_{ref}. First the considerations in choosing T_{ref} will be described, then the method of developing tables to keep track of the inert gas tension in that tissue will be described.

Choosing the Reference Tissue

The basic premise of the Repetitive/Multi-Level Dive Tables is that for any dive starting after all tissues have been saturated at 1 ATA (a bounce dive), given the inert gas tension of any one of the nine halftime tissues used by the EL-MK 15/16 RTA, the tensions of all eight other tissues can be calculated from the equation:

$$(1) \qquad P_i = P_A - (P_A - P_I)\{(P_{ref} - P_A)/(P_I - P_A)\}^{K_i/K_{ref}}$$

where:

P_i = tissue tension in tissue with time constant K_i
P_A = arterial inert gas tension at depth
P_I = tissue tensions after saturation at the surface
P_{ref} = tissue tension in tissue with time constant K_{ref}
K_i = $\ln 2/T_i$
K_{ref} = $\ln 2/T_{ref}$
T_i, T_{ref} = tissue halftimes

If a particular inert gas tension for the reference tissue (P_{ref}) with a particular halftime (T_{ref}) is given, the tension for any other tissue can be computed from equation 1 at any depth. Fig. 1 shows a plot of tissue tension vs tissue halftime for the different depth/bottom time combinations. All tissues were initially saturated at 1 ATA then descent was made to some depth. At depth, the tension in a particular tissue at any time, T, is given by the exponential uptake equation:

$$(2) \qquad P = P_A - (P_A - P_I)\, e^{-K \cdot T}$$

Equation 2 can be solved for T. The time, T, at any given depth for a tissue with a specified value of K to reach a given tension can then be found and this time can be used in equation 2, to find the tensions for tissues with other values of K. Equation 1 was derived from equation 2 in this way.

The plot in Fig. 1 shows the tissue distribution after a particular time T after three different depths. At depth D_2, the tissue tension for the reference tissue with halftime T_{ref} is given as P_{ref}, and all other tissue tensions are computed from equation 1. If the same procedure is followed for the same value of P_{ref} at a depth greater than D_2, the curve labeled D_3 results. For depths less than D_2, the curve labeled D_1 results. Note that for a given reference tissue tension, P_{ref}, that as depth increases all tensions for faster tissue increase and all tensions for slower tissues decrease (although the decrease in the tension of slower tissues is very small). This phenomenon makes it necessary to choose P_{ref} such that it is the slowest tissue which will control any dive in a particular set of dive tables and to always choose a table for the maximum depth ever attained during a dive (Control Depth) when doing multiple level diving. Only in this way can one ensure that when using an equivalent bottom time at a deeper depth, based on a single reference tissue tension, that none of the faster tissue tensions will be less than predicted from the equivalent bounce dive tissue tension distribution. This will be discussed more fully later on.

In developing the EL-MK 15/16 RTA, the 120 min halftime tissue was the slowest tissue controlling any of the tested dive profiles. Tissues with halftimes of 160, 200 and 240 min were used in the decompression model but these tissues only controlled dives below the limit line in the decompression tables; that is, outside of the normal operational depth/time domain. For a given reference tissue tension, the tensions in faster tissues will change as depth changes as shown in Fig. 1. The relationship is complex, but in Fig. 1 it is obvious that the 5 min tissue tension changes between the three depths are much greater than for the 10 or 20 min tissue. As a matter of fact, as the halftime approaches 120 min, the tissue tension change with depth approaches 0. The farther away a given tissue halftime is from the reference tissue halftime, the larger the tissue tension change with depth. For this reason, it is desirable to pick as small a T_{ref} as possible to prevent the repetitive dive procedure from becoming too conservative. However, T_{ref} must not be so small as to create large differences in tensions for slower tissues.

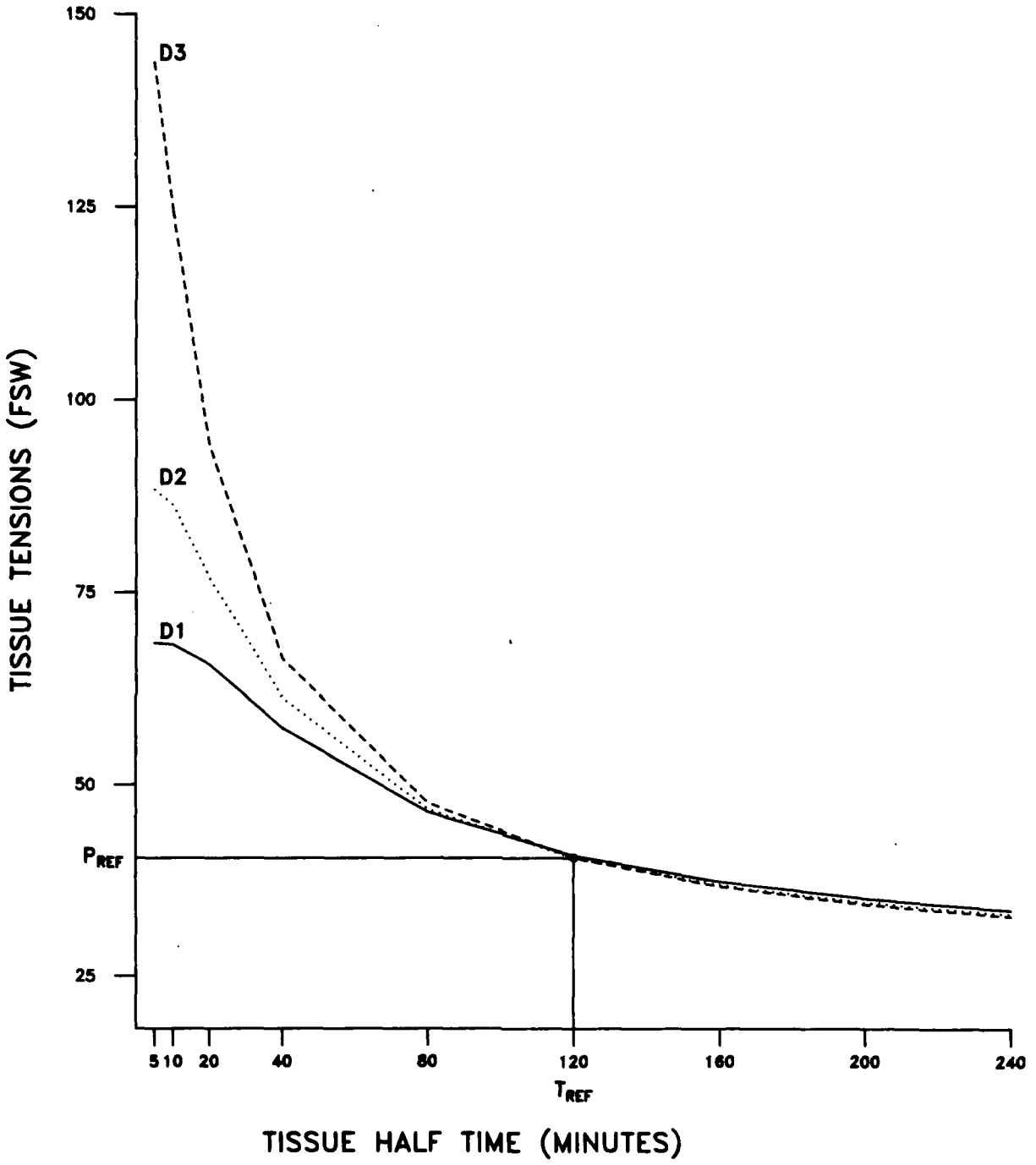

FIGURE 1. TISSUE TENSION DISTRIBUTION AFTER 3 DIFFERENT TIMES AT 3 DIFFERENT DEPTHS. Dives all begin after all tissues have been saturated at 1 ATA. The depth/bottom time combinations of all 3 dives are such that the resultant tension in the 120 min tissue is the same. Depth/Bottom Time distributions are as follows: D_1-60 FSW/80 min; D_2-80 FSW /50 min; D_3-140 FSW/25 min. See Table 2 for actual tissue tension values.

As previously mentioned, all dives above the limit line in the final set of decompression tables computed from the EL-MK 15/16 RTA had the maximum controlling tissue halftime 120 min or less (2). Also, it was this tissue tension which was used to compute the repetitive groups for the Standard Air Repetitive Dive Tables. Based on these considerations, the reference tissue was chosen as the 120 min tissue. Although for deeper equivalent dives this will result in lower tissue tensions for slower tissues, it will make no difference because these tissues will never control any of the decompression stops. However, for tissues which do control stops, the tissue tensions predicted by deeper equivalent dive profiles will always be equal to or greater than those computed in real time by the EL-MK 15/16 RTA. If, in the future, the limit line for the constant 0.7 ATA PO_2 in N_2 Tables is moved to include tables in which halftime tissues greater than 120 min control stops, the procedures presented in this report will have to be reevaluated.

Categorizing Dive Profiles

Having chosen a T_{ref} of 120 min, all dives were catagorized by the tension in this tissue. Since it was desirable to do both multiple level diving and repetitive diving, two different categorizations (called repetitive groups) were used. For doing repetitive dives, where all required decompression had been done and an interval taken at a shallow depth to allow for some offgassing, the tissue tensions which are of interest are those at the completion of the 10 FSW stop, since once these tensions are reached, surfacing is possible. This repetitive group is called the letter (or surfacing) repetitive group and is given one of the 16 letter designators, A-O or Z. In order to retain compatibility with the Standard Air Tables, the same 16 letter designators were used for the letter repetitive groups (6). However, since the maximum permissible surfacing tension in the 120 min tissue differs between the Standard Air Tables and the EL-MK 15/16 RTA, the repetitive groups differ in the absolute tissue tension they represent. In the EL-MK 15/16 RTA, the arterial nitrogen tension at the surface is 24.57 FSW[1] (2) and this will be the tissue tension after saturation at 1 ATA. The maximum permissible surfacing tension for the 120 min tissue is 45.5 FSW and no dive can surface with a greater tension. Since the allowable depth error in the EL-MK 15/16 RTA is 1 FSW, a P_{ref} 1 FSW greater than the 1 ATA saturation value (25.57 FSW) was defined as the lowest gas tension which need be considered in defining the letter repetitive groups. The 16 letter repetitive groups were defined as representing the 16 equally spaced increments between the tensions 25.57 FSW and 45.5 FSW, each increment having a value of 1.2456 FSW. Repetitive group A is defined as a P_{ref} equal to or greater than 25.57 FSW but less than 26.8156 FSW, repetitive group B as a P_{ref} equal to or greater than 26.8156 FSW but less than 28.0612 FSW and so on. Repetitive group Z represents a P_{ref} equal to or greater than 44.2540 FSW up to and including the maximum permissible value of 45.5 FSW.

[1] Tensions given in FSW are partial pressures such that 33 FSW = 1 ATA = 760 mmHg.

These 16 groups are conceptually similar to the 16 letter group used for Standard Air Table Repetitive Dive Procedures (6). In that procedure, the ambient inert gas tension at 1 ATA was considered to be 33 FSW and the lowest repetitive group gas tension which was considered was 35 FSW. The surfacing tension for the 120 min tissue was 64.5 FSW and each repetitive group represented a 2 FSW interval. Since, however, the Standard Air Tables were computed assuming 100% inert gas, this 2 FSW change represents only a 1.58 FSW change when the calculation is done using air with an inert gas fraction of 70%. The end result is that the constant 0.7 ATA PO_2 in N_2 repetitive group divisions are slightly smaller than those used for air tables. This consideration becomes important when considering how to use the procedures described in this report when an air dive from the Standard Air Tables precedes or follows a constant 0.7 ATA PO_2 in N_2 dive.

In doing multiple level diving, changes between depths may occur with no intervening offgassing period. In these cases the tissue tensions of interest are those which exist just before the depth change occurs, or after completion of the bottom time as shown in the decompression tables. This second repetitive group designation which was used is called the numerical (or bottom) repetitive group. This group is simply the actual value of P_{ref}, rounded up to the next whole number, just before decompression is begun. For no-decompression dives, the inert gas tension in the 120 min halftime tissue just before ascent is begun is usually within 1 FSW of what it will be at the surface because very little change will occur during the 60 FSW/min ascent. For decompression dives, there are usually large differences between the bottom and surfacing tensions because there may be considerable offgassing in the 120 min tissue during the decompression stops. Note that there is always a maximum value for the letter repetitive group since the EL-MK 15/16 RTA will not allow any dive to surface with an inert gas tension exceeding 45.5 FSW in the 120 min tissue. However, there is no theoretical maximum for the numerical repetitive group since the inert gas tension at depth is limited only by the actual depth and time spent at that depth. However, the maximum numerical group for use with the Repetitive/Multi-Level Dive procedures described in this report was limited to a maximum value of 60.

Repetitive/Multi-Level Group Dive Tables

Having decided to catagorize dives by a letter repetitive group designator representing the tension in the reference tissue after completion of the 10 FSW decompression stop and by a numerical repetitive group designator representing the tension just before beginning ascent, it was now necessary to compute these groups. All dive tables are found in Appendix A. Tables A-1 and A-2 in are the decompression tables computed for depths in feet of seawater (FSW) showing repetitive group designators. (Table A-1M and A-2M are the corresponding tables computed for depths in meters of seawater, MSW). The computer program used to generate these tables (Program TBLP7R; see ref. 10) is a modification of the program used to compute the decompression tables in reference 2. In the tables in Appendix A, the "(6)" after the Repetitive Group Designator is the array subscript for the 120 min tissue (9). This number tells which of the 9 halftime tissues, having array subscripts 1-9 is used as the reference tissue.

Table A-2 will be described first since it is the most straightforward. The same discussion applies to Table A-2M which was computed by program TBLP7R using depths in meters (10). The subroutine used to compute the repetitive group designation (subroutine RPET7 of ref. 10) used the 120 min tissue tension just before leaving the 10 FSW stop to get the letter group and the 120 min tissue tension just before leaving the bottom depth to get the numerical group. In computing the letter group designator, the convention was used that that if the 120 min tissue tension was exactly equal to the upper limit of tissue tension for a given group, it was assigned to the next higher group. Thus, a dive will have a letter group designator of A if the 120 min tissue tension at the end of the 10 FSW stop is less than 26.8156 FSW. If it exactly equals this value it will have a letter group designator of B. All dives having 120 min tension equal to or greater than 26.8156 FSW but less than 28.0612 FSW will be in group B. If the tension equals 28.0612 FSW it will be in group C. This convention is used all the way up to group Z for dives having a 120 min tissue tension equal to or greater than 44.2540 FSW up to and including 45.5 FSW. Since group Z is the largest group, and since the EL-MK 15/16 RTA will allow a tension of exactly 45.5 FSW to exist in the 120 min and still allow surfacing, a tension of exactly 45.5 FSW was defined as still being in group Z.

The numerical group designator in Table A-2 was assigned based on the 120 min tissue tension at the instant ascent is begun from the bottom depth. A value of 0.9 FSW is added to the tissue tension then the resulting number truncated. Thus, if the tissue tension just before decompression is 29.1 FSW it will be assigned a numerical group designator of 30, but if it is 29.09 FSW it would be assigned a numerical designator of 29.

In constructing Table A-2, it was necessary to deviate from the exact format previously used in publishing these tables (2). First of all, the no-decompression limit for 40 FSW is its actual value of 367 min in these tables rather than artificially cut off to 365 min as it was previously. Next, the limit line for the 60 FSW schedules was moved up to follow the 60/280 schedule because the largest numerical repetitive group considered in this procedure was a value of 60. It should also be noted that the decompression schedules in Table A-2 and reference (2) differ slightly from those initially published in the U.S. Navy Diving Manual (7) with respect to no-decompression limits. The no-decompression limits at 50, 60, 110, 120, 130 and 150 FSW are all 1 min longer and the 140 FSW limit 2 min longer in Table A-2 and Tables in reference 2 compared to Tables in the Diving Manual (7). These differences result from an improved method in computing no-decompression limits and the values in Table A-2 should be the ones in current use.

In Table A-2 numerical group designators are given for values up to 60, even if the schedule is below the limit line. This was necessary because the procedure may require decompression on a schedule below the limit line but will never require decompressing on a schedule with a numerical group greater than 60. The largest letter designator is group Z but no letter designator is

provided for any schedule below the limit line. Limiting the numerical and letter group designator places two restrictions on the use of the Repetitive/Multi-Level Dive Procedures described here. One is that repetitive diving is not allowed for any schedules below the limit line. The second is that a diver must surface from a given depth and terminate his dive if the sum of his residual nitrogen time plus bottom time exceeds that for the decompression schedule just above the limit line at his actual depth. However, when doing multiple level diving, the diver may find himself on a decompression schedule at the Control Depth which is below the limit line. Since the Control Depth may be deeper than the actual depth, as will be explained later, this condition does not require dive termination so long as the Control Depth is deeper than the actual depth, and the sum of bottom time plus residual nitrogen time at the actual depth does not exceed the limit line schedule time. These constraints were somewhat arbitrary but are designed to keep the diver within the tested depth/time domain of the EL-MK 15/16 RTA.

Table A-1 categorizes the no-decompression dives. The same discussion also applies to Table A-1M. In this table, the times in each row represent the largest bottom time at the specified depth which will allow the 120 min tissue to just remain in the specified letter repetitive group after ascent to the 10 FSW stop at a rate of 60 FSW/min. The repetitive group designation was calculated at 10 FSW because it is at this depth where offgassing to the maximum allowable surfacing tension (surfacing MPTT, see ref. 2) must occur before ascent to the surface is allowed. For example, at 60 FSW after a bottom time of 9 min (1 min descent plus 8 min at 60 FSW) and then ascent to 10 FSW at 60 FSW/min the tissue tension in the 120 min tissue will be less than 26.8156 FSW (the dividing tension between repetitive group A and B). If the bottom time is just 1 min longer, the 120 min halftime tissue tension will be 26.8156 FSW or greater, and the dive would be a group B dive. The largest bottom time considered was 720 min (12 hrs) and any maximum bottom times less than this in the table are the no-decompression limits at that depth.

The times in Table A-1 were computed to the limits of the letter repetitive group designators, but for each time the resultant numerical group designator was also computed. Because some offgassing occurs during decompression, there was not always a one to one correspondence between the letter group and number group. For instance, for all dives down to 120 FSW in group A, the associated numerical group was 27 but below 120 FSW it was 26. Table A-1 was constructed such that the listed numerical repetitive groups were the largest associated with that particular letter group at any depth. However, the largest differences between numerical groups associated with a given letter group was 1 FSW. In Table 1, Table A-1 has been reproduced to show at what depths the numerical group associated with a particular letter group changes. For depth/time combinations within the solid line border, the appropriate numerical group is the one shown just below the letter group at the top of the table. For depth/time combinations outside the border, the exact numerical group is 1 FSW less than that shown under the letter group. Table 1 is presented for completeness only, in the procedures described in Appendix A, only the numerical group designations below the letter group in Table A-1 are used.

At depths of 20 and 30 FSW, if the bottom time exceeds 720 min, the repetitive group designation does not increase because the 120 min halftime

TABLE 1

Repetitive Group Designations for
No-Decompression Dives

2:42 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

NO-DECOMPRESSION DIVES

REPETITIVE GROUP DESIGNATOR (6)
BOTTOM TIME (MIN)

DEPTH (FSW)	A 27	B 28	C 30	D 31	E 32	F 33	G 35	H 36	I 37	J 38	K 40	L 41	M 42	N 43	O 45	Z 46
20	154	423	720													
30	31	50	73	98	128	165	211	273	373	634	720					
40	17	27	38	50	63	76	91	107	125	144	167	192	222	258	304	367
50	12	19	26	34	42	50	59	68	78	88	99	111	123	137	143	
60	9	14	20	25	31	37	43	50	57	64	71	74				
70	7	11	16	20	25	30	34	39	45	50	51					
80	6	10	13	17	21	25	29	33	37	39						
90	5	8	11	14	18	21	24	28	31	32						
100	5	7	10	13	15	18	21	24	27							
110	4	6	9	11	14	16	19	21	24							
120	4	6	8	10	12	15	17	19								
130	3	5	7	9	11	13	15	16								
140	3	5	7	8	10	12	13									
150	3	4	6	8	9	11										
160	3	4	6	7	9											
170		4	5	7	8											

Letter and numerical repetitive group designators are at the head of each column in the table. Numbers in the body of the table are bottom times in min. Bottom times within the solid line border have numerical groups as listed at the head of each column. Bottom times outside of the border have groups one less than the numerical group value shown at the top of the column.

tissue has saturated at that repetitive group tension. At depths 40 FSW and below, the last time entry in each row is the no-decompression limit, for longer bottom times one must consult Table A-2. Note that there is no group A bottom time at 170 FSW, simply because the 120 min tissue tension is already above 26.8156 FSW upon arrival at 170 FSW. Finally, all times shown in Tables A-1 (A-1M) and A-2 (A-2M) are bottom times and include descent time from the surface.

Computing Offgassing Credit

As previously noted, repetitive diving involves an interval where tissue offgassing occurs. These intervals are called shallow intervals and may be taken at 1 ATA (a surface interval) or at any depth down to 30 FSW. If the arterial inert gas tension is less than the 120 min halftime tissue tension, desaturation may occur and the repetitive group will decrease. While this may theoretically occur at any depth, credit in these procedures is given only at depths 30 FSW and shallower. Tables A-3 through A-7 of Appendix A allow one to determine what the repetitive group reduction should be for a given offgassing pe iod. Tables A-3 through A-7 were all computed for depths in feet of seawater by program SICT7 and the source listing for this program is given elsewhere (10). The three depths used were 10, 20, and 30 FSW. These depths are so close to the corresponding metric depths of 3, 6 and 9 MSW that these same tables are also used for metric diving with an insignificant error.

Shallow Interval Credit Tables For Letter Repetitive Groups (0, 10 FSW): Tables A-3 and A-4 were designed for determining the repetitive group reduction after all required decompression has been completed. The starting group is the letter group which as previously pointed out, represents the inert gas tension in the 120 min tissue at the completion of the 10 FSW stop. In computing these tables, the starting tissue tension is always taken as the highest tension which is allowed in a given repetitive group and is the dividing line between successive groups. Thus, for group A the starting tension was 26.8156 FSW, for group B it was 28.0612 FSW, increasing in 1.2456 FSW increments up to group Z for which a starting tension of 45.5 FSW was used. The times in the tables represent the time in min. for the 120 min halftime tissue to decay from its starting tension to the exact tension in a given numerical group. In order to see how the initial computation was done, shift the final group designations as shown in the tables one to the left. Thus, using Table A-3, if one starts out in group B (initial tension 28.0612 FSW), in 3 min the tension has decreased to 28 FSW, in 63 min it has decreased to 27 FSW, in 155 min to 26 FSW and in 363 min to 25 FSW. If left in this format, one would go to the next shorter time if the exact surface interval time were not found in the table. In most Navy Diving Tables, the convention is to go to the next larger time if the exact time is not found in the table. In order to be able to use this convention with Table A-3 and A-4, the final repetitive group designators were shifted one to the left, as they appear in Appendix A. In this way, one goes to the next longer surface interval for times not found in the table. If the starting group is B, after 63 min the 120 min tissue tension is exactly 27 FSW. But, in Table A-3 an interval of exactly 63 min would still have a group designator of 28. If the surface interval is 64 min the tension will be less than 27 FSW, but since all tensions are rounded up the appropriate repetitive group designator should

still be 27. Only after 155 min has the 120 min tissue tension been reduced enough such that it will be right at a value of 26. However, because of the convention used in Table A-3 the interval must be greater than 155 min before a final group designator of 26 is allowed. Thus, while at first it may seem that using the next larger surface interval if the exact one is not found, underestimates the final group designation, in fact it slightly overestimates it. This slight additional conservatism is the result of shifting the final group designators one to the right. If the times spent at 0 or 10 FSW exceed those in the final group 26 column, the finishing group is 25 and the 120 min is considered completely desaturated and the following dive is considered "clean".

The equations used to compute the times in Table A-3 and A-4 are those from the EL-MK 15/16 RTA (2). In particular, equation 16-A in Appendix A of reference 2 is used when the total tissue tension exceeds ambient (see equation 10-A, reference 2). When tissue tension falls below this value, the previously linear offgassing becomes exponential and equation 8-A of reference 2 will apply. One will immediately note that for a given time interval, the repetitive group reduction at 10 FSW is greater than at the surface. This is because in Table A-3 air with a PO_2 of 0.21 ATA is the assumed breathing medium while at 10 FSW the assumed breathing medium is a 0.7 ATA PO_2 in N_2. This difference in PO_2 makes offgassing at 10 FSW approximately 5 times faster than at the surface. This means that if one takes the interval at 10 FSW rather than at 0 FSW, a much greater repetitive group reduction can be obtained in a given time. Since the offgassing rate is dependent only on inspired PO_2 and not depth, Table A-4 could be used for 1 ATA surface intervals provided a 0.7 ATA PO_2 (or higher) in N_2 breathing medium is used for the entire surface interval. Breathing 100% O_2 at the surface would meet this criteria. When breathing a high PO_2 at the surface, Table A-4 may be used even if breathing is interrupted or delayed. The important thing is that the total time actually breathing a 0.7 ATA PO_2 or greater must be greater than or equal to the time in the table. This is possible because for all letter repetitive groups the tissue inert gas tension always exceeds that at 1 ATA breathing air. Thus, if breathing a high PO_2 is interrupted, offgassing is slowed but there will never be any gas uptake. Using Table A-4 at 1 ATA is possible because the ambient nitrogen tension at 1 ATA is less than that used in computing the table and the tissue tension at which offgassing changes from linear to exponential is less at 1 ATA than at 10 FSW. These same considerations, however, make it impossible to use a given offgassing table at a deeper depth, even if the inspired PO_2 is the same. See reference 2 for details.

The instructions for the 0.7 ATA constant PO_2 in N_2 Decompression Tables allow the 10 FSW stop to be taken at 20 FSW without increasing total decompression time. Table A-3 or A-4 may be used even in this circumstance provided that the entire shallow interval is spent 10 FSW or shallower. This is because Table A-3 switches from linear to exponential decay when the tissue tension reaches 38.7 FSW, or at final repetitive group 39. At 20 FSW, the EL-MK 15/16 RTA will switch to an exponential decay at 48.7 FSW or a tension above group Z. Thus, for the largest surfacing repetitive group, the entire decay at 20 FSW will be much slower than predicted by Table A-3. For this reason, in order to use Table A-3, the entire shallow interval must be spent 10 FSW or shallower.

It was desirable to allow some degree of compatibility between the Repetitive Groups for the U.S. Navy Standard Air Tables and those described in this report. This involves equating the letter groups used in the U.S. Navy Standard Air Tables with the Final Numerical Group Deisgnators in Table A-3 and A-4. Since there are 22 numerical group designators and only 16 letter groups, some letter groups will have to encompass more than one number group. Since the absolute values for the Standard Air Repetitive Groups are different from those used in defining the letter groups in this report, using corresponding tissue tensions was not possible. Instead, the Final Standard Air letter groups in Tables A-3 and A-4 were chosen such that the time intervals required to end up in a given letter group were equal to or longer than those for the same starting group in the Residual Nitrogen Timetable for Repetitive Air Dives in the U.S. Navy Diving Manual (7). However, because of the way the Residual Nitrogen Timetable was constructed and certain inconsistencies within the table (8), there are some exceptions to this rule. These exceptions involve the time until the diver is considered "clean" and in the surface interval required to attain a final group designator of A. If the starting group is I or greater, all times in Table A-3 are longer than in the Diving Manual Residual Nitrogen Timetable. If the starting group is from group D to group H, the times in Table A-3 to reach group A are shorter than in the Diving Manual Residual Nitrogen Timetable. Also, in order for a diver to be "clean", the Diving Manual Residual Nitrogen Timetable requires a 12 hour surface interval. Table A-3 requires shorter intervals for starting groups of H or less. Notwithstanding these inconsistencies, Table A-3 is used to compute the final numerical group after a surface interval given the letter group from a previous air dive. Also, if an air dive follows a 0.7 ATA PO_2 in N_2 dive, Tables A-3 and A-4 are used to find the letter group at the end of the surface interval for a subsequent air dive. This letter group is used to find a Residual Nitrogen Time for that air dive. Note than when a Standard Air Dive precedes or follows a 0.7 ATA PO_2 in N_2 dive, it is Table A-3 which is used for determining the final repetitive group for all surface intervals, not the Diving Manual Residual Nitrogen Timetable.

Shallow Interval Credit Tables for Numerical Repetitive Groups (10, 20, 30 FSW): Tables A-5, A-6 and A-7 are used when the decompression stop at the depth of the particular table has not been completed. The diver is always obligated to take all decompression stops at the depths below the depth of the table when ascending. Since decompression has not been completed, there may be an inert gas tension in the 120 min tissue above the 45.5 FSW value for group Z. In Table A-5, the maximum starting group is 56. The Maximum Permissible Tissue Tension (MPTT) for the 120 min tissue at 10 FSW for the EL-MK 15/16 RTA (see VVAL18, Table 7 of reference 2) is 55.5 FSW which rounds up to 56 FSW. At 20 FSW the 120 min MPTT rounds up to 66 FSW, but as previously noted the maximum allowable numerical group allowed in these procedures is limited to a maximum value of 60.

The arterial inert gas tension assumed by the EL-MK 15/16 RTA at 10 FSW is low enough such that offgassing will always occur, so all time spent at 10 FSW will count towards reduction of repetitive groups. This is not so at 20 FSW and 30 FSW. At 20 FSW, the EL-MK 15/16 RTA assumes an arterial inert gas tension of 28.4 FSW. This means that if the starting repetitive group tension is 29 FSW, no change in repetitive group status will occur. If it is less, the 120 min tissue will take up gas. Table A-1 shows that if one starts at

the surface, after 154 min the 120 min tissue tension will be approximately 27 FSW and after 423 min it will be approximately 28 FSW. In Table A-1, the final group shown at 20 FSW is 30, but in fact the maximum group one can be in at 20 FSW is 29. As you will recall, the largest numerical group associated with a given letter group was used as the numerical group in Table A-3. So, while the 20 FSW dive had a numerical group of 29, dives in the 30-70 FSW range have numerical groups of 30 and this was the one associated with group C in Table A-1. At 30 FSW, the arterial nitrogen tension is 38.4 FSW so the maximum numerical group is 39. Table A-1 shows this maximum group as 40 because dives in the 40-60 FSW range have numerical groups of 40 (Table 1). The practical application of this is that at depths of 20 FSW or 30 FSW, if the starting numerical group is less than the lowest starting group in Table A-6 or A-7, offgassing cannot take place and Table A-1 will be used to find out how much of a repetitive group increase will occur for time spent at these depths.

The times in Table A-5 through A-7 were computed in the same manner as for Table A-3 and A-4 except that the starting tissue tension was set equal to the starting numerical group value. The final group designators have been shifted one to the right as with Tables A-3 and A-4 so one chooses the next larger time interval if the exact interval cannot be found in the table. No final letter group designators are given because Tables A-5 through A-7 cannot be used in conjunction with Standard Air Tables. Even though starting 120 min tissue tensions above 60 are possible, 60 was chosen as the maximum allowable numerical group for these procedures.

Control Depth

Tables A-1 through A-7 are the tools used to compute multiple level and repetitive dives. In order to use these tools, certain concepts and rules must be developed. These will then be brought together to form a comprehensive set of instructions. The Control Depth was defined earlier as the maximum depth ever attained at any time during a dive. As discussed in detail earlier, any shallower schedule can be represented as a deeper schedule for a shorter time with the same reference tissue tension. However, for all tissues with halftimes less than the reference tissue halftime, tissue tensions will be higher, thus the decompression time for the equivalent deeper schedule will always be equal to or greater than the shallower schedule. In doing multiple level diving, a decompression schedule is constructed at the Control Depth, which takes into account times spent at all shallower depths. Table 2 shows the tissue tensions which would exist after 3 different bottom times at three different depths for the same 120 min tissue tension. Because all bottom times are rounded to the nearest minute, the 120 min tissue tensions are not exact but are all very close and range from 40.68 to 40.40 FSW. Note that for the dive to 60 FSW all tissue tensions for tissues faster than the 120 min tissue are less than those for the 80 or 140 FSW dives even though the 120 min tissue is almost the same for each profile. Even though the 120 min tissue tensions are almost the same, the three dives can hardly be called equivalent. After 80 min at 60 FSW, only 4 min of decompression is required while after 50 min at 80 FSW, 15 min of decompression is required and after 25 min at 140 FSW, 34 min of decompression is required. If a diver goes to 140 FSW after spending 80 min at 60 FSW, the real time algorithm would start with the tissue tension distribution for the 60/80 schedule and begin updating tissues at

140 FSW starting with the 60 FSW distribution. In the multiple level dive procedure done by the tabular method, the diver would convert his 80 min at 60 FSW to an equivalent time of 25 min at 140 FSW. This will be a conservative procedure because the 140/25 schedule predicts higher tissue tension in all tissues with halftimes less than 120 min than would actually exist after 80 min at 60 FSW. In fact, this conversion would immediately increase the diver's decompression obligation by 30 min. The converse is not true in that if a diver spent 25 min at 140 FSW and then went to 60 FSW, the bottom time of 80 min as predicted by the 120 min tissue tension would allow surfacing with only 4 min of decompression, even though 34 min are required according to the 140/25 schedule. This is because the predicted tissue tensions for all tissues less than 120 min halftime are lower, for a given 120 min tissue tension, at shallower depths. Now, if one always picks a schedule at the deepest depth ever attained, the resulting decompression schedule will always be longer than one predicted by the EL-MK 15/16 RTA computing a schedule in real time. If depths are changed without any intervening offgassing period, either by decompression stops or a surface interval, then picking a schedule at the Control Depth for the final decompression schedule ensures that actual decompression time will never be underestimated. However, it is reasonable to assume that after spending some time shallow the Control Depth could be decreased for subsequent dives. The EL-MK 15/16 RTA predicts a surface interval of over 18 hours before one could consider the 120 min halftime tissue completely desaturated after which time the Control Depth would be 0.0. The problem is to determine whether there is sufficient desaturation after shorter intervals which would allow the Control Depth to be reduced for a subsequent dive, without causing underestimation for decompression on subsequent dives.

The problem with decreasing the Control Depth is illustrated in Table 3. There are three pairs of dives in this table, one dive to 150 FSW paired with one at 50 FSW. In each pair, the 120 min tissue tensions are very close. In each of the 150 FSW dives, the tissue tensions are those after all decompression has been completed at the 10 FSW stop. In these cases, the 120 min tissue tension was used to determine the appropriate letter group. (The numerical group for the 150 FSW dives was determined from the tissue tension just before beginning decompression which are not shown). If after completion of decompression from 150 FSW the diver descended to 50 FSW with no interval at 10 FSW or less, the EL-MK 15/16 RTA would begin with tissue tension shown for the 150 FSW dives. In this procedure, only the 120 min tension is being kept track of, and the remaining tensions are computed at the new depth using equation 1, given the 120 min tensions. The tensions in the 50 FSW row show the distribution for all other tissues given only the 120 min tension. In order to be mathematically conservative, a surface interval should be taken to allow all tissue tensions for tissues faster than the 120 min tissue to decay to those which would exist after the equivalent bottom time at 50 FSW. After the 150/11 dive, the 10 min tissue will take the longest decay from its surfacing value of 90.42 FSW to the value of 57.30 FSW as shown for the 50/50 dive, a period of 115 min. At the higher 0.7 ATA PO_2 at 10 FSW, the offgassing rate will be about 5 times faster so the required shallow interval at 10 FSW would be about 23 min. After decompressing from a 150/15 dive the 10 min tissue still has the longest decay time and the surface interval would increase to 137 min at the surface breathing air and 27 min at 10 FSW breathing a 0.7 ATA PO_2. After decompressing from the 150/20, the 10 min

TABLE 2

Tissue Tensions for Three Depth/Bottom Time Combinations Having the Same Reference Tissue Tension Just Before Beginning Decompression

Body of table shows tissue tension in FSW*

Depth/Time (FSW/min)	Tissue Halftime (min) 5	10	20	40	80	120@	160	200	240	Repet Groups
60/80	68.40	68.22	65.59	57.31	46.36	40.68	37.32	35.11	33.55	L(41)
80/50	88.33	86.29	76.78	61.17	46.71	40.35	36.82	34.57	33.02	K(41)
140/25	143.74	124.40	93.89	66.25	47.54	40.40	36.65	34.33	32.76	J(41)

* 33 FSW = 1 ATA = 760 mmHg

@ Reference Tissue

tissue tension has decreased to 93.1 FSW and now it is the 20 min tissue which has the longest time, 132 min at 1 ATA. The surface intervals, 115 min, 137 min and 132 min are the minimum times required such that all tissue tensions will have decayed from their 150 FSW surfacing values to those bottom values for the 50 FSW dives with the same 120 min tissue tension. After this time, there will be no tissue tension exceeding the value predicted from the equivalent 50 FSW dives.

At first glance, a minimum 1 ATA surface interval of 137 min or a 10 FSW interval of 27 min would seem to be the minimum required, but the above analysis neglects the fact that the 10 and 20 min tissues will continue offgassing at 50 FSW until a value of 58.4 FSW is reached (the assumed arterial tension at 50 FSW). In fact, these faster tissues will offgas much faster at 50 FSW than at the surface because of the higher PO_2. There is, however, another consideration. The limitation placed on the EL-MK 15/16 RTA, if used to compute real time decompression schedules, is that ascent to a depth 30 FSW or shallower is required if the inert gas tension in the 40 min halftime tissue exceeds 77 FSW and descent below 30 FSW is not allowed until the 40 min tissue tension has dropped to 48 FSW (2). The MPTT for the 40 min tissue will require it to attain a value of 56 FSW or less before surfacing is allowed. (See VVAL18, reference 2). To comply with the restrictions placed on the EL-MK 15/16 RTA, the maximum tissue tension drop for the 40 min tissue after completion of the 10 FSW stop would be (56-48 =) 8 FSW. At the surface breathing air this would take 112 minutes and at 10 FSW breathing a 0.7 ATA PO_2 it would take 23 min. These times are fairly close to the ones arrived at previously. From a practical point, a reduction of three repetitive group intervals at the surface was chosen as the minimum required interval for a decrease in Control Depth. In Tables A-3 or A-4, if the surface interval is greater than the one just to the left of the solid line, the Control Depth may be reduced to 0 or 10 FSW as appropriate and the following dive will be a repetitive dive. If the interval is equal to or less than the value just to the left of the solid line then no reduction in Control Depth is allowed and the dive is a multi-level dive. In Table A-3 the three repetitive group minimum interval was applied to all starting groups except for group A where a one group minimum was used. AT 10 FSW, the three group minimum interval was used except for groups B-E where a two group minimum was used and group A where a 1 group minimum interval was used.

Having defined the shallow interval required before the Control Depth can change, we are now in a position to better define a repetitive dive and a multi-level dive. A repetitive dive will be defined as a dive where an interval falling to the right of the solid line in Tables A-3 and A-4 was taken after all required decompression has been taken. Thus, in a repetitive dive the Control Depth will decrease to 0 FSW or 10 FSW after the shallow interval. In a multiple-level dive either no shallow interval is taken or if one is taken, it is not long enough to allow a decrease in Control Depth. In a multiple-level dive, the Control Depth will either stay the same or increase with each successive segment of the dive.

TABLE 3

Comparison of Surfacing Tensions After 150 FSW Dives With Bottom Tensions After 50 FSW Dives For The Same 120 Min Tissue Tension.

Body of table shows tissue tension in FSW*

Depth/Time (FSW/min)	Tissue Halftime (min) 5	10	20	40	80	120@	160	200	240	Repet Groups
150/11	119.34	90.42	64.45	46.72	36.28	32.53	30.59	29.42	28.63	F(33)
50/50	58.36	57.30	52.29	44.02	36.25	32.97	31.09	29.89	29.07	F(33)
150/15	115.98	97.20	71.90	51.93	39.48	34.91	32.50	30.99	29.97	H(35)
50/60	58.36	57.85	54.08	46.31	38.18	34.39	32.24	30.86	29.90	H(35)#
150/20	88.78	93.10	75.33	55.83	42.47	37.31	34.55	32.77	31.52	J(39)
50/80	58.40	58.26	56.24	49.85	41.38	37.01	34.41	32.71	31.50	J(38)

* 33 FSW = 1 ATA = 760 mmHg

@ Reference Tissue

The numerical group designator from Table A-1 is 36 when in fact the 120 min tissue tension shows it to be 35. The reason is that the exact 60 min bottom time is not in Table A-1.

Tensions for all 150 FSW dives are those upon completion of the 10 FSW stop. Tensions for all 50 FSW dives are those at the completion of the bottom time, just before ascent is started.

Ascents, Descents and Time Intervals

The final subject which needs to be addressed is handling ascent and descent times and time intervals. All times in Tables A-2 and A-3 include descent time so all times at any depth which is deeper than a previous depth should include the descent time. Generally, ascent times of 60 FSW/min are taken into account in Tables A-3 and A-4 so if ascent is 60 FSW/min, no corrections need be made. If ascent is much slower than 60 FSW/min then the additional time should be added to the time spent at the deeper depth. If ascent is much faster, the diver must make up the time at the shallower depth before beginning his shallow interval.

All times in the procedures described in this report are rounded up to the next minute. This simplifies the procedure and allows it to be used during a dive to take any unanticipated excursions into account.

DISCUSSION

Tables A-1 through A-7 comprise the tables necessary to utilize all features of the Multi-Level/Repetitive Dive Procedure. Detailed instructions for actually computing dives are given in Appendix A and several examples are given to illustrate the procedure. These procedures and instructions should be reviewed to fully understand the following discussion. The overall concept is to build a decompression schedule at the Control Depth to get the final decompression schedule. The Control Depth may be decreased if a long enough shallow interval is taken. After the first segment of a multiple level dive the numerical group designator for that decompression schedule (obtained from Table A-1 or A-2) is used to reenter these tables to find a starting schedule at the next depth which has the same numerical group designator, the so called equivalent dive schedule. The time actually spent at the next depth is added to the bottom time of this equivalent dive schedule (Starting Time) and the final bottom time is found. The numerical group designator of the schedule having the final bottom time at the new depth is used to find a decompression schedule at the Control Depth with the same numerical group and this becomes the schedule the diver would follow to the surface. The Control Depth will always be the deepest depth ever attained during a dive, unless a shallow interval is taken. Once proficient, this procedure can be done during a dive with a minimum amount of writing. One simply keeps track of the repetitive group at the current depth and chooses the Control Depth schedule with the same numerical repetitive group designator to decompress on. The Control Depth may change during a dive but unless a sufficient shallow interval is taken, it can only increase, never decrease, since it is determined by the deepest depth ever attained.

An abbreviated example shows the rapidity with which the procedure can be carried out. Consider the following multiple level profile, all notations in depth/bottom time:

100/15 → 80/40 → 60/30 → 90/10 → decompress

The idea is to choose the final decompression schedule. The Control Depth is 100 FSW. The numerical repetitive group changes are shown in Table 4.

TABLE 4

Multi-Level Dive Example

Schedule		Repet Group		Decompression Schedule
Start	Finish	Start	Finish	
Surface	100/15	25	31	100/15
80/17 + 40 →	80/57	31	43	100/45
60/90 + 30 →	60/120	43	47	100/55
90/70 + 10 →	90/80	47	52	100/70

All times include descent time to the next depth at 60 FSW/min. All schedule notations are Depth/Bottom Time (FSW/min).

The dive in Table 4 starts at the surface with a numerical group designator of 25 which is the starting numerical group for all clean dives. The initial decompression schedule is a 100/15 with a numerical repetitive group of 31. Note that all subsequent decompression schedules will be for the 100 FSW Control Depth since this is the deepest depth ever attained. At 80 FSW, the diver starts with a numerical repetitive group of 31 (the 80/17 decompression table) and after a 40 min stay at this depth is on the 80/57 schedule which has a numerical repetitive group of 43. The 100 FSW schedule with a numerical group of 43 is the 100/45 and the diver would use this schedule if ascent to the surface was to be done at this point. The 60 FSW schedule with a numerical group of 43 is the 60/90. After spending 30 min at 60 FSW, the appropriate schedule is the 60/120 and the numerical repetitive group increases to 47 and the appropriate decompression schedule at the Control Depth is the 100/55. On the last leg of the dive, the starting 90 FSW schedule has a 70 min bottom time and as a result of the additional 10 min at 90 FSW, the repetitive group goes from 47 to 52 so in the end the diver decompresses on the 100/70 schedule. The total dive time was 95 min but using this multiple level dive procedure the diver decompresses on a 100/70 schedule (total decompression time = 80:40) instead of a 100/95 schedule (TDT = 144:40) which would have been required under the old total time of maximum depth rule.

Table 5 shows the same dive as in Table 4 with the decompression profile as computed by the EL-MK 15/16 RTA. (Program DMDB7 using VVAL18, see reference 9). The Zero Time column shows time in minutes while the Elapsed Time column shows times between successive dive segments. If one plotted Zero Time vs Depth, one would obtain a graph of the dive profile. Note that the final ascent to the surface in Table 5 requires a 16.05 min (16 min 3 sec)

stop at 20 FSW and 38.12 min stop at 10 FSW for a total ascent time from 90 FSW of 55.67 min. In Table 4, using the Multi-Level/Repetitive Dive Procedure the diver would be obligated to decompress on a 100/70 schedule, which from Table A-2 requires 80 min 40 sec of decompression. If the diver had been using a UDC programmed with the EL-MK 15/16 RTA he could have saved over 23 min of decompression compared to the tabular method presented here.

If the diver ascends to a depth of 30 FSW or shallower, Table A-3 to A-7 is used to decide how much the repetitive group should be reduced. If all decompression is taken and Table A-3 or A-4 is used, the Control Depth will be reduced if a sufficiently long surface interval is taken. If the shallow interval is not to the right of the solid line or if Table A-5 through A-7 is used, then the repetitive group will decrease but the Control Depth will remain the same or increase, depending on the depth of the next dive segment.

The limit lines in Table A-2 reflect the longest decompression schedule which should be used in normal operations. However, in doing multiple level dives, the decompression schedule at the Control Depth may in fact go over the limit line (see Example 7, Appendix A). Since the procedure used for constructing a multiple-level dive decompression table at the Control Depth is very conservative, this is expected and does not require the dive be terminated. However, it was decided to impose the limitation that if the sum of the starting time and the actual time at the current depth puts a diver on a decompression schedule which is over the limit line at the current depth, then the dive must be terminated. These limitations are evidenced in Table A-2 by the fact that there are no letter repetitive groups for schedules over the limit line but numerical group designators are given up to a group of 60 even for schedules over the limit line. Since the maximum value for the numerical repetitive group after any dive above the limit line is 60, a Control Depth Schedule with a numerical group greater than 60 will never be needed. The absence of a letter repetitive group for dives below the limit line, makes it impossible to compute a numerical repetitive group value for doing a repetitive dive. Thus, repetitive diving below the limit line cannot be done.

The Multi-Level/Repetitive Dive procedures presented in this report may be used in conjunction with U.S. Navy Standard Air Decompression Tables. Generally, the rate of offgassing predicted by the EL-MK 15/16 RTA will be slower than those for the model used to compute Standard Air Tables. Thus, one should always use Table A-3 to compute the final repetitive group even if the starting group is a Standard Air Repetitive Group. Upon the completion of a dive using the 0.7 ATA constant PO_2 in N_2 tables in this report, Table A-3 is used to compute the repetitive group reduction and the final numerical repetitive group designator is converted to a letter group for use with Standard Air Tables. Even though the absolute values of the tensions for the Standard Air Table repetitive groups differ from those used in this report, they still constitute 16 equal divisions and this is the most important point. At 80 FSW, the PO_2 using air is very close to 0.7 ATA and one should then be able to compare 80 FSW schedules from Table A-1 with the no-decompression limits and Repetitive Dive Group Designation Table from the Diving Manual (7). If the bottom times from the latter are used to find repetitive groups in Table A-1, the groups will be less up through a 10 min bottom time. For

TABLE 5

Decompression Profiles as Computed by The EL-MK 15/16 RTA

For the Profile in Table 4

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 0

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
1.67	1.67	100	0	.70 ATA
15.00	13.33	100	-60	.70 ATA
15.33	.33	80	0	.70 ATA
55.33	40.00	80	-60	.70 ATA
55.67	.33	60	0	.70 ATA
85.67	30.00	60	60	.70 ATA
86.17	.50	90	0	.70 ATA
95.67	9.50	90	-60	.70 ATA
96.83	1.17	20	0	.70 ATA
112.88	16.05	20	-60	.70 ATA
113.05	.17	10	0	.70 ATA
151.17	38.12	10	-60	.70 ATA
151.34	.17	0	0	.70 ATA

All times in min; Depths in FSW; Rates in FSW/min. Values under gas show % nitrogen or PO_2 in ATA.

longer times the resulting repetitive group using Table A-1 will be the same or greater than those shown in the Diving Manual. In Table A-2, the letter group designators for a given bottom time at 80 FSW is larger or equal to those in the Standard Air Decompression schedules in the Diving Manual.

The tables in Appendix A provide a high degree of flexibility and are not difficult to use once proficiency is obtained. Tables A-1, A-2, and A-3 are equivalent to the No-Decompression Tables, Decompression Tables and Surface Interval Credit Tables already in use for standard air tables. In the procedure presented in this report, no Residual Nitrogen Timetable is presented because the residual nitrogen time for a given numerical repetitive group at any depth is found simply by using the bottom time of the schedule at that depth with the same or next larger numerical group. If no multiple level diving is desired, Tables A-1, A-2, and A-3 are all that are needed and repetitive diving can be done in exactly the same manner as currently done with Standard Air Decompression Schedules. Table A-4 provides the added convenience of taking advantage of the more rapid offgassing at 10 FSW (or the surface) breathing a high 0.7 ATA PO_2, which would be useful for diving where long shallow transits are expected. Although Tables A-5 through A-7 give the total flexibility for the procedure presented here, they are not necessary for multiple-level diving. One need only make the rule that at 30 and 20 FSW repetitive groups may increase but not decrease, that is no offgassing is allowed. In this way Table A-5 through A-7 will be eliminated, simplifying the procedure at the expense of some additional decompression time.

Appendix A contains instructions for the entire Repetitive/Multi-Level Dive Procedure. It will be up to Fleet users to decide how much of the procedure to use and what format to publish the tables in. One point must be made, however, the Repetitive/Multi-Level Dive Procedure described here is no substitute for a functioning Underwater Decompression Computer (UDC), nor is it meant to be. In diving with a UDC, the UDC monitors depth and continuously updates the diver's decompression obligation, thus relieving the diver of all computational responsibility. When using the tabular method described here, not only are the resultant decompression tables a lot longer than would be predicted by a UDC using the EL-MK 15/16 RTA but the divers' attention is occasionally diverted from the task at hand during the dive to compute and update his decompression status. Once an operational UDC is available, the tables in this report should rapidly become obsolete and only be retained for emergency use in the event of a UDC failure.

Tables 6 through 12 show what the decompression profiles in the seven examples in Appendix A would be if the diver had been wearing a UDC programmed with the EL-MK 15/16 RTA. These printouts show the times in minutes and depth in FSW. Rates are in FSW/min and in the gas column is shown either the % N_2 or PO_2 in ATA. Comparing Table 6 with Example 1 in Appendix A shows that the EL-MK 15/16 RTA would require a 27.57 min (27 min 34 sec) stop at 10 FSW, whereas Figure A-1 of Appendix A shows the Current Decompression Schedule to be the 100/55 which requires 56 min in stops. In Table 7, the EL-MK 15/16 RTA would require only a 6.41 min stop at 10 FSW after the last 120 FSW excursion

TABLE 6

EL-MK 15/16 RTA Profile for Example 1, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 1

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
1.67	1.67	100	0	.70 ATA
21.00	19.33	100	-60	.70 ATA
21.67	.67	60	0	.70 ATA
51.67	30.00	60	60	.70 ATA
52.33	.67	100	0	.70 ATA
62.33	10.00	100	-60	.70 ATA
63.83	1.50	10	0	.70 ATA
91.40	27.57	10	-60	.70 ATA
91.57	.17	0	0	.70 ATA

TABLE 7

EL-MK 15/16 RTA Profile for Example 2, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 2

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
1.67	1.67	100	0	.70 ATA
21.00	19.33	100	-60	.70 ATA
21.67	.67	60	0	.70 ATA
51.67	30.00	60	60	.70 ATA
52.33	.67	100	0	.70 ATA
62.33	10.00	100	-60	.70 ATA
63.83	1.50	10	0	.70 ATA
91.40	27.57	10	-60	.70 ATA
91.57	.17	0	0	.70 ATA
226.57	135.00	0	60	79.00 %
228.57	2.00	120	0	79.00 %
236.57	8.00	120	-60	.70 ATA
238.40	1.83	10	0	.70 ATA
244.81	6.41	10	-60	.70 ATA
244.98	.17	0	0	.70 ATA

TABLE 8

EL-MK 15/16 RTA Profile for Example 3, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 3

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
1.67	1.67	100	0	.70 ATA
21.00	19.33	100	-60	.70 ATA
21.67	.67	60	0	.70 ATA
51.67	30.00	60	60	.70 ATA
52.33	.67	100	0	.70 ATA
62.33	10.00	100	-60	.70 ATA
63.83	1.50	10	0	.70 ATA
91.40	27.57	10	-60	.70 ATA
91.57	.17	0	0	.70 ATA
146.40	54.83	0	60	.70 ATA
147.74	1.33	80	0	.70 ATA
172.74	25.00	80	-60	.70 ATA
173.90	1.17	10	0	.70 ATA
173.90	0.00	10	-60	.70 ATA
174.07	.17	0	0	.70 ATA

TABLE 9

EL-MK 15/16 RTA Profile for Example 4, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 4

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
1.67	1.67	100	0	.70 ATA
30.00	28.33	100	-60	.70 ATA
31.50	1.50	10	0	.70 ATA
51.50	20.00	10	60	.70 ATA
53.33	1.83	120	0	.70 ATA
61.33	8.00	120	-60	.70 ATA
63.17	1.83	10	0	.70 ATA
80.13	16.96	10	-60	.70 ATA
80.30	.17	0	0	.70 ATA

TABLE 10

EL-MK 15/16 RTA Profile for Example 5, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 5

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
2.50	2.50	150	0	.70 ATA
20.00	17.50	150	-60	.70 ATA
22.00	2.00	30	0	.70 ATA
23.80	1.80	30	-60	.70 ATA
23.97	.17	20	0	.70 ATA
113.80	89.83	20	-60	.70 ATA
113.97	.17	10	0	.70 ATA
113.97	0.00	10	-60	.70 ATA
114.14	.17	0	0	.70 ATA
179.14	65.00	0	60	79.00 %
181.64	2.50	150	0	79.00 %
194.14	12.50	150	-60	.70 ATA
196.30	2.17	20	0	.70 ATA
197.64	1.34	20	-60	.70 ATA
197.81	.17	10	0	.70 ATA
206.57	8.76	10	-60	.70 ATA
206.74	.17	0	0	.70 ATA

TABLE 11

EL-MK 15/16 RTA Profile for Example 6, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 6

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
1.67	1.67	100	0	.70 ATA
21.00	19.33	100	-60	.70 ATA
22.17	1.17	30	0	.70 ATA
45.00	22.83	30	60	.70 ATA
46.50	1.50	120	0	.70 ATA
56.50	10.00	120	-60	.70 ATA
58.33	1.83	10	0	.70 ATA
70.73	12.40	10	-60	.70 ATA
70.90	.17	0	0	.70 ATA

TABLE 12

EL-MK 15/16 RTA Profile for Example 7, Appendix A

PROGRAM DMDB7 USING 10 FSW STOPS
VVAL18(NITROGEN)

EXAMPLE 7

ZERO TIME	ELAPSED TIME	DEPTH	RATE	GAS
0.00	0.00	0	60	79.00 %
0.00	0.00	0	0	79.00 %
0.00	0.00	0	60	.70 ATA
2.17	2.17	130	0	.70 ATA
20.00	17.83	130	-55	.70 ATA
22.00	2.00	20	0	.70 ATA
142.00	120.00	20	50	.70 ATA
144.60	2.60	150	0	.70 ATA
154.60	10.00	150	-60	.70 ATA
155.43	.83	100	0	.70 ATA
170.43	15.00	100	-10	.70 ATA
178.43	8.00	20	0	.70 ATA
184.33	5.90	20	-10	.70 ATA
185.33	1.00	10	0	.70 ATA
305.33	120.00	10	26	.70 ATA
308.41	3.08	90	0	.70 ATA
337.41	29.00	90	-60	.70 ATA
338.74	1.33	10	0	.70 ATA
341.13	2.39	10	-60	.70 ATA
341.29	.17	0	0	.70 ATA

whereas the Current Decompression schedule in Figure A-2 is the 120/40 requiring 56 min in decompression stops. Table 8 shows the last 80 FSW excursion to be a no-decompression dive while Figure A-3 shows that 63 min of decompression would be required. Comparing Figure A-4 with Table 9, if the diver had been wearing a UDC he would have saved himself 26 min of decompression.

In Example 5 of Appendix A, the 90 min stay at 20 FSW allows direct ascent to the surface, as does the EL-MK 15/16 RTA profile in Table 10. However, if the diver spent 65 min at the surface and then did a 150 FSW for 15 min dive, the EL-MK 15/16 RTA would require a Total Decompression Time of 12.6 min. Figure A-5 shows the diver surfaces in Repetitive Group H and Table A-3 of Appendix A shows the final repetitive group to be 34. The 150 FSW schedule in Table A-2 with the next largest numerical group is the 150/15 which gives the diver a 15 min Residual Nitrogen Time at 150 FSW so he must decompress on a 150/30 after his 15 min stay. This will require 64.5 min of decompression. Table 11 shows that 16 min of decompression could have been saved with a UDC compared with the 120/30 schedule required by the tabular method as shown in Example 6 of Appendix A. Finally, Table 12 shows only a 5.9 min stop required during ascent from 100 FSW to 10 FSW and a 2.39 min stop during ascent from the final 90 FSW segment of Example 7 of Appendix A. Figure A-7 shows that 69 min of stops are required in ascending from 100 to 10 FSW and 80 min of stops would be required on the final ascent from 90 FSW.

It is obvious from comparison of Tables 6 through 12 with Figure A-1 through A-7 that a functioning UDC will save incredible amounts of decompression time compared to using the tabular method described in this report for computing decompression schedules. This excessive decompression time resulting from use of the tabular method is a direct result of keeping track of only a single tissue tension and in using the worst case assumption which had to be made regarding surfacing tensions. It must be remembered that the computer algorithm used to compute the decompression profiles in Table 6-12 was thoroughly tested on similarly complex multiple-level and repetitive dives and is safe (2). So, it is strictly the conservative nature of the tabular method which results in excessively long decompression times. Only with a functioning UDC can multiple level and repetitive diving be made truly efficient, and all unnecessary decompression eliminated.

CONCLUSIONS

1. The procedures in Appendix A of the report can be used for repetitive and multiple-level diving in instances where an Underwater Decompression Computer (UDC) is not available.

2. The procedures in Appendix A are complex and will require a formal training course. Reformatting of the tables and instructions should be done to meet Fleet needs and teaching requirements.

3. In order to keep the procedures for the Repetitive/Multi-Level Dive Procedures from becoming too complex, they had to be made conservative and usually result in decompression schedules far in excess of those which would be required by a functioning UDC.

4. A functioning UDC is the preferred method of doing multiple-level or repetitive diving and should be used wherever possible.

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APPENDIX A

MK 15/16 CONSTANT 0.7 ATA PO_2

IN N_2 DECOMPRESSION TABLES

AND

MULTI-LEVEL/REPETITIVE DIVE TABLES

INSTRUCTIONS AND EXAMPLES

TABLE SUMMARY

Decompression Tables

Table A-1 (A-1M): Repetitive Group Designators for No-Decompression Dives.

Use to find the letter or number repetitive group designator for a given no-decompression depth/time combination. If the exact bottom time is not found in the body of the table, go to the column with the next larger time.

Also, use to find the bottom time at a given depth corresponding to a given numerical repetitive group designator. If the exact depth is not found, go to the row with the next deeper depth. If a given numerical repetitive group designator is not found, go to the column with the next larger numerical repetitive group.

All decompression tables are designed to be used with a PO_2 of 0.7 ATA or greater and a nitrogen diluent. All times include the descent time at the designated rate.

Table A-1M is the same as Table A-1 except depths are in Meters of Seawater (MSW).

Table A-2 (A-2M): Tables and Repetitive Group Designators for Decompression Dives.

Use to find the letter or number repetitive group designator for a given depth/time combination. If the exact depth and/or time is not found, go to the next larger depth and/or time.

Also, use to find the bottom time at a given depth corresponding to a given numerical group designator. If the exact depth is not found, go to the schedules at the next greater depth. If a given repetitive group designator is not found, go to the schedule with the next larger group.

All decompression tables are designed to be used with a PO_2 of 0.7 ATA or greater and a nitrogen diluent. All times include the descent time at the designated rate.

Table A-2M is the same as Table A-2 except depths are in Meters of Seawater.

Shallow Interval Credit Tables
All Required Decompression Completed

Table A-3: Surface Interval Credit Table.

Use to find the final numerical repetitive group for a particular starting letter group and surface interval. All times in the body of the table are in minutes and show the elapsed time after the surface is reached. It is assumed air is being breathed, but any gas with a PO_2 of 0.21 or greater may be breathed.

The starting repetitive group designator is found from Table A-1 or A-2. Using that row, move across to the column to the surface interval time. If the exact time is not found, go to the next greater time. Read the final numerical repetitive group designator from the last row of that column. If surface intervals exceed those in the last column, the final repetitive group designator is 25.

If intervals to the right of the solid line are used, the control depth will be Zero after that interval. The standard repetitive group designators show the standard air repetitive group associated with a oxygen numerical repetitive group designator.

Table A-4: Shallow Interval Credit Table, 10 FSW (or 3 MSW), for Letter Repetitive Group.

Use this table after all required decompression stops have been taken. The 10 FSW decompression stop may be taken at 10 or 20 FSW but the shallow interval must be 10 FSW or shallower and a PO_2 of 0.7 ATA or greater must be breathed for the entire shallow interval. Table A-4 may be used at the surface if the PO_2 breathed is 0.7 ATA or greater. If breathing of the 0.7 ATA constant PO_2 is interrupted for more than 5 min at 10 FSW use Table A-3, or ascend to the surface, count any time on air as dead time, and use Table A-4 breathing a PO_2 of 0.7 ATA or greater. If Table A-4 is used breathing a high PO_2 mix at the surface, any time spent on air is dead time and simply not counted as part of the interval time.

Use the same instructions as for Table A-3 to find the final numerical repetitive group. The interval times begin after completion of any required 10 FSW stop time and after 10 FSW has been reached.

If the 10 FSW interval is to the right of the solid line, then the control depth will be 10 FSW upon completion of the interval. The standard air repetitive group designators show the standard air repetitive group associated with a given numerical repetitive group designator.

Table A-4 is used also at 3 MSW when using metric depths.

Shallow Interval Credit Tables
Decompression Not Completed

Table A-5: Shallow Interval Credit Table, 10 FSW (or 3 MSW) for Numerical Repetitive Groups.

Use this table only after all required decompression stops up to and including the 20 FSW stop have been taken. The shallow interval must be 10-13 FSW (3-4 MSW) and the breathing gas 0.7 ATA (or greater) constant PO_2 in N_2.

If the shallow interval depth goes below 13 FSW use Table A-6. If depth is shallower than 10 FSW, return to 10 FSW, stay for the required 10 FSW stop time, and then use Table A-4.

Find the numerical repetitive group designator for the appropriate depth/time combination from Table A-1 or A-2. Using the corresponding row from the first column of the table, move across the columns until the shallow interval time is found. The shallow interval begins when a depth of 10 FSW is reached. If the exact shallow interval time is not found, go to the column with the next greater time. Find the final numerical repetitive group from the last entry in the column. If times are larger than those shown in the last column, the final group is 25. If the numerical repetitive group designator from Table A-1 or A-2 is greater than 56, the starting repetitive group designator is 56. When using this table, the control depth remains unchanged upon completion of the shallow interval.

Table A-5 is used also at 3 MSW using metric depths.

Table A-6: Shallow Interval Credit Table, 20 FSW (or 6 MSW), for Numerical Repetitive Groups.

Use this table after all required decompression stops up to and including the 30 FSW stop have been completed. The shallow interval must be 20-23 FSW (6-7 MSW) and the breathing gas 0.7 ATA (or greater) constant PO_2 in N_2.

If the shallow interval goes below 23 FSW, use Table A-7. If depth goes shallower than 20 FSW, return to 20 FSW, stay for the required 20 FSW stop time, ascend to 10 FSW, and use Table A-5.

Find the starting and finishing repetitive groups in the same way as for Table A-6. The shallow interval time begins when 20 FSW is reached. If the starting numerical repetitive group designator is 29 or less, no reduction in repetitive group for time spent at 20 FSW is allowed and in some cases, the repetitive group may increase, see Table A-1. When using this table, the control depth remains unchanged upon completion of the shallow interval.

Table A-6 is used at 6 MSW using metric depths.

Table A-7: Shallow Interval Credit Table, 30 FSW (or 9 MSW), for Numerical Repetitive Groups.

Use this table after all required decompression stops up to and including the 40 FSW stop have been completed. The shallow interval must be 30-33 FSW (9-10 MSW). If the shallow interval goes below 33 FSW, treat all time as if spent at 40 FSW and use the appropriate multiple level dive procedure. If the depth goes shallower than 30 FSW, return to 30 FSW, stay for the required 30 FSW stop time, ascend to 20 FSW and use Table A-6.

Find the starting and finishing repetitive groups in the same way as for Table A-6. The shallow interval time begins when 30 FSW is reached. If the starting numerical repetitive group designator is 39 or less, no reduction in repetitive group for time spent at 20 FSW is allowed and in some cases, the repetitive group may increase, see Table A-1. When using this table, the control depth remains unchanged upon completion of the shallow interval.

Table A-7 is also used at 9 MSW using metric depths.

Table A-8: Multi-Level/Repetitive Dive Worksheet.

The worksheet assists in determination of the final decompression schedule for any dive. A repetitive dive is any dive where a period is spent at a depth 10 FSW (or 3 MSW) or shallower and has a shallow interval which allows a reduction in control depth. A multi-level dive is any dive where the shallow interval does not allow a decrease in Control Depth.

DECOMPRESSION TABLES

Tables A1, A-1M, A2, A-2M are designed to be used with a MK 15 or MK 16 UBA with a PO_2 set point of 0.7 ATA or greater and a nitrogen or nitrogen-oxygen diluent. Tables A-1 and A-2 are in feet of seawater (FSW), while Table A-1M and A-2M are in meters of seawater (MSW).

TABLE A-1

Repetitive Group Designtors for No-Decompression Dives
Feet of Seawater (FSW)

2:42 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

NO-DECOMPRESSION DIVES

REPETITIVE GROUP DESIGNATOR (6)
BOTTOM TIME (MIN)

DEPTH (FSW)	A 27	B 28	C 30	D 31	E 32	F 33	G 35	H 36	I 37	J 38	K 40	L 41	M 42	N 43	O 45	Z 46
20	154	423	720													
30	31	50	73	98	128	165	211	273	373	634	720					
40	17	27	38	50	63	76	91	107	125	144	167	192	222	258	304	367
50	12	19	26	34	42	50	59	68	78	88	99	111	123	137	143	
60	9	14	20	25	31	37	43	50	57	64	71	74				
70	7	11	16	20	25	30	34	39	45	50	51					
80	6	10	13	17	21	25	29	33	37	39						
90	5	8	11	14	18	21	24	28	31	32						
100	5	7	10	13	15	18	21	24	27							
110	4	6	9	11	14	16	19	21	24							
120	4	6	8	10	12	15	17	19								
130	3	5	7	9	11	13	15	16								
140	3	5	7	8	10	12	13									
150	3	4	6	8	9	11										
limit line																
160	3	4	6	7	9											
170		4	5	7	8											

TABLE A-2

Tables and Repetitive Group Designators for Decompression Dives

Feet of Seawater (FSW)

Tables of different depth groupings are separated by a solid line. Within each group is a limit line. Profiles above the limit line are the only ones used in planning a dive. Profiles below the limit line are for emergency use only. Each profile is backed up by profiles down to 10 FSW deeper and up to 20 minutes longer.

The 10 FSW stop may be taken at 20 FSW without changing the 10 FSW stop time. Ascent to the surface is made from 20 FSW at 60 FSW/min after a stop equivalent to the sum of the 10 and 20 FSW stop.

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
40	367	0:40													0	0:40	Z46
limit line																	
40	370	0:30													1	1:40	46
40	380	0:30													2	2:40	46
40	390	0:30													3	3:40	46
50	143	0:50													0	0:50	044
50	150	0:40													4	4:50	045
50	160	0:40													8	8:50	Q45
50	170	0:40													12	12:50	046
50	180	0:40													16	16:50	Z47
50	190	0:40													19	19:50	Z47
50	200	0:40													22	22:50	Z48
50	210	0:40													25	25:50	Z49
50	220	0:40													29	29:50	Z49
50	230	0:40													33	33:50	Z50
50	240	0:40													38	38:50	Z50
50	250	0:40													42	42:50	Z51
50	260	0:40													46	46:50	Z51
50	270	0:40													49	49:50	Z52
50	280	0:40													53	53:50	Z52
50	290	0:40													56	56:50	Z52
50	300	0:40													59	59:50	Z53
50	310	0:40													62	62:50	Z53
50	320	0:40													64	64:50	Z53
50	330	0:40													67	67:50	Z54
limit line																	
50	340	0:40													70	70:50	54

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
50	350	0:40													73	73:50	54
50	360	0:40													77	77:50	55
50	370	0:40													80	80:50	55
50	380	0:40													84	84:50	55
50	390	0:40													87	87:50	55
60	74	1:00													0	1:00	L40
60	80	0:50													4	5:00	L41
60	90	0:50													9	10:00	M43
60	100	0:50													13	14:00	N44
60	110	0:50													17	18:00	O45
60	120	0:50													25	26:00	O47
60	130	0:50													32	33:00	O48
60	140	0:50													39	40:00	O49
60	150	0:50													45	46:00	Z50
60	160	0:50													50	51:00	Z51
60	170	0:50													56	57:00	Z52
60	180	0:40													4	59 64:00	Z53
60	190	0:40													8	62 71:00	Z54
60	200	0:40													12	65 78:00	Z55
60	210	0:40													16	68 85:00	Z56
60	220	0:40													19	71 91:00	Z56
60	230	0:40													22	74 97:00	Z57
60	240	0:40													25	76 102:00	Z58
60	250	0:40													28	79 108:00	Z58
60	260	0:40													30	82 113:00	Z59

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
60	270	0:40												32	85	118:00	Z60
60	280	0:40												36	87	124:00	Z60
limit line																	
60	290	0:40												40	89	130:00	
60	300	0:40												44	92	137:00	
60	310	0:40												47	94	142:00	
60	320	0:40												51	96	148:00	
60	330	0:40												54	98	153:00	
60	340	0:40												57	100	158:00	
60	350	0:40												60	102	163:00	
60	360	0:40												63	105	169:00	
60	370	0:40												66	108	175:00	
60	380	0:40												68	111	180:00	
60	390	0:40												71	114	186:00	
70	51	1:10													0	1:10	K39
70	60	1:00													9	10:10	K41
70	70	1:00													18	19:10	L43
70	80	1:00													25	26:10	M45
70	90	0:50												3	28	32:10	N47
70	100	0:50												8	33	42:10	O48
70	110	0:50												12	39	52:10	O50
70	120	0:50												16	45	62:10	O52
70	130	0:50												19	51	71:10	Z53
70	140	0:50												22	56	79:10	Z55
70	150	0:50												29	58	88:10	Z56
70	160	0:50												36	62	99:10	Z57

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
70	170	0:50												43	65	109:10	Z59
limit line																	
70	180	0:50												48	70	119:10	60
70	190	0:40											1	53	73	126:10	
70	200	0:40											2	57	76	136:10	
70	210	0:40											6	57	80	144:10	
70	220	0:40											11	56	84	152:10	
70	230	0:40											14	59	86	160:10	
70	240	0:40											18	62	89	170:10	
70	250	0:40											21	65	92	179:10	
70	260	0:40											24	69	93	187:10	
70	270	0:40											27	71	97	196:10	
70	280	0:40											29	75	99	204:10	
70	290	0:40											31	78	102	212:10	
70	300	0:40											33	81	105	220:10	
70	310	0:40											35	83	110	229:10	
70	320	0:40											37	86	113	237:10	
70	330	0:40											42	85	118	246:10	
70	340	0:40											45	86	124	256:10	
70	350	0:40											49	88	127	265:10	
80	39	1:20													0	1:20	J38
80	40	1:10													1	2:20	J38
80	50	1:10													15	16:20	K41
80	60	1:10													27	28:20	L43
	70	1:00												9	28	38:20	M46
	80	1:00												18	28	47:20	N48

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
80	90	1:00												25	34	60:20	051
limit line																	
80	100	0:50											3	28	42	74:20	53
80	110	0:50											8	28	50	87:20	55
80	120	0:50											12	29	57	99:20	57
80	130	0:50											16	36	57	110:20	59
80	140	0:50											19	42	62	124:20	60
80	150	0:50											21	49	66	137:20	
80	160	0:50											24	55	70	150:20	
80	170	0:50											29	57	75	162:20	
80	180	0:50											36	57	79	173:20	
80	190	0:50											43	56	84	184:20	
80	200	0:40										1	47	60	86	195:20	
80	210	0:40										2	52	64	89	208:20	
80	220	0:40										3	56	68	92	220:20	
80	230	0:40										7	56	73	96	233:20	
80	240	0:40										11	56	77	99	244:20	
80	250	0:40										14	57	80	104	256:20	
80	260	0:40										18	57	84	109	269:20	
80	270	0:40										21	59	85	116	282:20	
80	280	0:40										24	63	85	123	296:20	
80	290	0:40										27	66	85	130	309:20	
80	300	0:40										29	70	88	133	321:20	
80	310	0:40										31	73	91	137	333:20	
80	320	0:40										33	76	94	141	345:20	
90	32	1:30													0	1:30	J37

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
90	40	1:20													14	15:30	J40
90	50	1:10												3	28	32:30	L43
90	60	1:10												17	28	46:30	M46
90	70	1:00											1	28	28	58:30	N49
limit line																	
90	80	1:00											10	29	34	74:30	52
90	90	1:00											19	28	43	91:30	55
90	100	1:00											26	28	52	107:30	57
90	110	0:50										4	28	32	57	122:30	59
90	120	0:50										9	28	40	62	140:30	62
90	130	0:50										13	28	49	66	157:30	
90	140	0:50										16	29	56	72	174:30	
90	150	0:50										19	36	56	76	188:30	
90	160	0:50										22	42	57	81	203:30	
90	170	0:50										24	49	57	88	219:30	
90	180	0:50										26	55	61	91	234:30	
90	190	0:50										32	56	67	94	250:30	
100	27	1:40													0	1:40	I37
100	30	1:30													6	7:40	J38
100	35	1:30													17	18:40	J40
100	40	1:30													28	29:40	K42
100	45	1:20												10	28	39:40	L44
100	50	1:20												19	28	48:40	L46
100	55	1:20												27	29	57:40	M47
100	60	1:10											7	28	28	64:40	N49
100	65	1:10											14	28	28	71:40	O51

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
limit line																	
100	70	1:10											20	28	31	80:40	53
100	75	1:10											26	28	36	91:40	54
100	80	1:00										3	28	29	41	102:40	56
100	90	1:00										13	28	28	52	122:40	59
100	100	1:00										21	28	33	61	144:40	61
100	110	1:00										27	29	43	65	165:40	
110	24	1:50													0	1:50	I37
110	25	1:40													3	4:50	I37
110	30	1:40													17	18:50	J39
110	35	1:30												2	28	31:50	K42
110	40	1:30												14	28	43:50	K44
110	45	1:30												25	28	54:50	L46
limit line																	
110	50	1:20											7	28	28	64:50	48
110	55	1:20											16	28	29	74:50	50
110	60	1:20											25	28	28	82:50	52
110	65	1:10										4	29	28	32	94:50	54
110	70	1:10										12	28	28	38	107:50	56
110	80	1:10										24	28	29	50	132:50	59
110	90	1:00									7	28	28	33	65	162:50	63
120	19	2:00													0	2:00	H35
120	20	1:50													1	3:00	I36
120	25	1:50													12	14:00	J38
120	30	1:40												4	24	30:00	J41
120	35	1:40												14	29	45:00	K43
120	40	1:30											5	23	28	58:00	L46

TABLE A-2

5:34 PM TUE. 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
limit line																	
120	45	1:30											12	28	28	70:00	48
120	50	1:20										2	21	28	28	81:00	50
120	55	1:20										6	27	29	28	92:00	53
120	60	1:20										14	29	28	32	105:00	55
120	70	1:10									3	28	28	29	48	138:00	59
120	80	1:10									17	28	28	30	68	173:00	63
130	16	2:10													0	2:10	H34
130	20	2:00													6	8:10	I37
130	25	1:50												5	17	24:10	J40
130	30	1:40											3	9	27	41:10	K42
130	35	1:40											7	20	28	57:10	L45
130	40	1:30										1	14	27	28	72:10	M48
limit line																	
130	45	1:30										7	20	28	28	85:10	50
130	50	1:30										13	26	28	29	98:10	53
130	60	1:20									7	26	28	28	42	133:10	58
130	70	1:20									23	28	28	28	66	175:10	62
140	13	2:20													0	2:20	G33
140	15	2:10													2	4:20	H34
140	20	2:00												4	7	13:20	J38
140	25	1:50											4	7	21	34:20	J41
140	30	1:40										2	7	13	28	52:20	L44
limit line																	
140	35	1:40										5	12	23	28	70:20	47
140	40	1:30									1	10	16	28	29	86:20	50
140	45	1:30									4	14	24	28	28	100:20	53
140	50	1:30									10	17	28	28	34	119:20	55

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 TBLP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
140	60	1:20								6	16	29	28	28	59	168:20	61
140	70	1:20								14	28	28	29	34	79	214:20	
150	11	2:30													0	2:30	F32
150	15	2:10												2	4	8:30	H35
150	20	2:00											2	7	10	21:30	J39
150	25	1:50										3	6	8	24	43:30	K42
150	30	1:40									1	7	8	17	29	64:30	L45
limit line																	
150	35	1:40									4	8	14	26	28	82:30	49
150	40	1:40									7	15	19	28	28	99:30	52
150	45	1:30								2	13	14	28	28	34	121:30	55
150	50	1:30								8	14	21	28	28	48	149:30	58
150	60	1:20							4	14	22	28	29	30	75	204:30	63
150	70	1:20							11	22	29	28	28	50	91	261:30	
limit line																	
160	9	2:40													0	2:40	31
160	10	2:30													1	3:40	32
160	15	2:10											1	4	5	12:40	36
160	20	2:00										1	6	7	13	29:40	40
160	25	1:50									1	7	7	10	26	53:40	43
160	30	1:50									7	7	10	20	29	75:40	47
160	40	1:40								7	11	14	23	28	35	120:40	54
160	50	1:30							5	14	14	26	28	29	63	181:40	60
limit line																	
170	8	2:50													0	2:50	31
170	10	2:40													3	5:50	32
170	15	2:10										1	3	3	7	16:50	36
170	20	2:00									1	4	7	7	17	38:50	41

TABLE A-2

5:34 PM TUE., 3 SEPT, 1985 T8LP7 VVAL18 (FEET)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 60 FPM; ASCENT 60 FPM

DEPTH (FSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (FSW) STOP TIMES (MIN) 130	120	110	100	90	80	70	60	50	40	30	20	10	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
170	25	2:00									7	7	6	13	28	63:50	44
170	30	1:50								6	7	7	13	24	28	87:50	48
170	40	1:40							6	8	14	14	27	28	44	143:50	56
170	50	1:30						3	13	14	17	28	28	35	75	215:50	63

TABLE A-1M

Repetitive Group Designators for No-Decompression Dives
Meters of Seawater (MSW)

2:43 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

NO-DECOMPRESSION DIVES

REPETITIVE GROUP DESIGNATOR (6)
BOTTOM TIME (MIN)

DEPTH (MSW)	A 27	B 28	C 30	D 31	E 32	F 33	G 35	H 36	I 37	J 38	K 40	L 41	M 42	N 43	O 45	Z 46
6	177	720														
9	32	52	76	103	135	174	226	299	427	720						
12	18	28	39	52	65	79	94	111	130	150	174	202	235	275	328	405
15	12	19	27	34	43	51	60	70	80	91	102	114	127	142	149	
18	9	15	20	26	32	38	44	51	58	65	73	77				
21	7	12	16	21	25	30	35	40	46	51	53					
24	6	10	13	17	21	25	29	33	38	41						
27	5	8	12	15	18	21	25	28	32	33						
30	5	7	10	13	16	19	22	25	28							
33	4	6	9	11	14	17	19	22	24							
36	4	6	8	10	13	15	17	20								
39	3	5	7	9	11	13	16									
42	3	5	7	9	10	12	13									
45	3	4	6	8	10	11										
46	3	4	6	8	9	10										
limit line																
48	3	4	6	7	9											
51		4	5	7	8											

TABLE A-2M

Tables and Repetitive Group Desinators For
Decompression Dives
Meters of Seawater (MSW)

Tables of different depth groupings are separated by a solid line. Within each group is a limit line. Profiles above the limit line are the only ones used in planning a dive. Profiles below the limit line are for emergency use only. Each profile is backed up by profiles down to 3 MSW deeper and up to 20 minutes longer.

The 3 MSW stop may be taken at 6 MSW without changing the 3 MSW stop time. Ascent to the surface is made from 6 MSW at 20 FSW/min after a stop equivalent to the sum of the 3 and 6 MSW stop.

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
12	370	0:36													0	0:36	Z45
limit line																	
12	405	0:36													0	0:36	46
15	149	0:45													0	0:45	044
15	150	0:36													1	1:45	044
15	160	0:36													5	5:45	045
15	170	0:36													9	9:45	046
15	180	0:36													12	12:45	Z46
15	190	0:36													15	15:45	Z47
15	200	0:36													18	18:45	Z48
15	210	0:36													21	21:45	Z48
15	220	0:36													24	24:45	Z49
15	230	0:36													29	29:45	Z49
15	240	0:36													33	33:45	Z50
15	250	0:36													37	37:45	Z50
15	260	0:36													40	40:45	Z51
15	270	0:36													44	44:45	Z51
15	280	0:36													47	47:45	Z51
15	290	0:36													50	50:45	Z52
15	300	0:36													53	53:45	Z52
15	310	0:36													56	56:45	Z52
15	320	0:36													59	59:45	Z53
15	330	0:36													61	61:45	Z53
limit line																	
15	340	0:36													64	64:45	53
15	350	0:36													67	67:45	54
15	360	0:36													70	70:45	54

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
15	370	0:36													73	73:45	54
15	380	0:36													77	77:45	54
15	390	0:36													80	80:45	55
18	77	0:54													0	0:54	L40
18	80	0:45													2	2:54	L41
18	90	0:45													7	7:54	M42
18	100	0:45													11	11:54	N44
18	110	0:45													14	14:54	N45
18	120	0:45													21	21:54	046
18	130	0:45													28	28:54	048
18	140	0:45													35	35:54	049
18	150	0:45													41	41:54	Z50
18	160	0:45													46	46:54	Z51
18	170	0:45													52	52:54	Z52
18	180	0:45													58	58:54	Z53
18	190	0:36												5	60	65:54	Z53
18	200	0:36												9	63	72:54	Z54
18	210	0:36												12	66	78:54	Z55
18	220	0:36												15	69	84:54	Z56
18	230	0:36												18	72	90:54	Z56
18	240	0:36												21	74	95:54	Z57
18	250	0:36												24	77	101:54	Z58
18	260	0:36												26	79	105:54	Z58
18	270	0:36												28	82	110:54	Z59
18	280	0:36												31	85	116:54	Z59

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
limit line																	
18	290	0:36												35	87	122:54	60
18	300	0:36												39	89	128:54	
18	310	0:36												42	91	133:54	
18	320	0:36												46	93	139:54	
18	330	0:36												49	95	144:54	
18	340	0:36												52	97	149:54	
18	350	0:36												55	99	154:54	
18	360	0:36												57	101	158:54	
18	370	0:36												60	104	164:54	
18	380	0:36												62	108	170:54	
18	390	0:36												65	110	175:54	
21	53	1:03													0	1:03	K39
21	60	0:54													7	8:03	K40
21	70	0:54													15	16:03	L42
21	80	0:54													23	24:03	M44
21	90	0:45												1	28	30:03	N46
21	100	0:45												6	31	38:03	O48
21	110	0:45												10	38	49:03	O50
21	120	0:45												14	43	58:03	O51
21	130	0:45												17	49	67:03	Z53
21	140	0:45												19	55	75:03	Z54
21	150	0:45												26	56	83:03	Z55
21	160	0:45												32	60	93:03	Z57
21	170	0:45												39	63	103:03	Z58
limit line																	
21	180	0:45												44	68	113:03	59

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
21	190	0:45												50	71	122:03	60
21	200	0:45												54	75	130:03	
21	210	0:36											3	56	78	138:03	
21	220	0:36											7	56	81	145:03	
21	230	0:36											11	57	84	153:03	
21	240	0:36											14	60	87	162:03	
21	250	0:36											17	64	88	170:03	
21	260	0:36											20	67	91	179:03	
21	270	0:36											23	69	94	187:03	
21	280	0:36											25	73	96	195:03	
21	290	0:36											27	76	99	203:03	
21	300	0:36											29	78	102	210:03	
21	310	0:36											31	81	105	218:03	
21	320	0:36											33	83	110	227:03	
21	330	0:36											36	84	114	235:03	
21	340	0:36											40	84	119	244:03	
21	350	0:36											44	85	123	253:03	
24	41	1:12													0	1:12	J38
24	50	1:03													13	14:12	K40
24	60	1:03													25	26:12	L43
24	70	0:54												7	28	36:12	M46
24	80	0:54												15	28	44:12	N48
24	90	0:54												23	33	57:12	050
24	100	0:45											1	28	40	70:12	052
limit line																	
24	110	0:45											6	28	48	83:12	54

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
24	120	0:45											10	28	55	94:12	56
24	130	0:45											14	34	56	105:12	58
24	140	0:45											17	40	60	118:12	60
24	150	0:45											19	47	64	131:12	
24	160	0:45											21	53	69	144:12	
24	170	0:45											26	56	72	155:12	
24	180	0:45											33	55	78	167:12	
24	190	0:45											39	56	81	177:12	
24	200	0:45											44	58	84	187:12	
24	210	0:45											50	62	86	199:12	
24	220	0:36										1	54	66	89	211:12	
24	230	0:36										3	56	70	93	223:12	
24	240	0:36										7	56	74	97	235:12	
24	250	0:36										11	56	78	100	246:12	
24	260	0:36										14	56	82	104	257:12	
24	270	0:36										17	58	83	111	270:12	
24	280	0:36										20	61	84	116	282:12	
24	290	0:36										23	64	84	123	295:12	
24	300	0:36										25	68	85	129	308:12	
24	310	0:36										27	71	89	131	319:12	
24	320	0:36										29	74	91	136	331:12	
27	33	1:21													0	1:21	J37
27	40	1:12													13	14:21	J40
27	50	1:03												1	28	30:21	K43
27	60	1:03												15	28	44:21	M46

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
27	70	1:03												26	28	55:21	N49
limit line																	
27	80	0:54											8	28	33	70:21	52
27	90	0:54											17	27	42	87:21	54
27	100	0:54											24	27	50	102:21	57
27	110	0:45										2	27	31	56	117:21	59
27	120	0:45										6	28	39	59	133:21	61
27	130	0:45										11	27	47	65	151:21	
27	140	0:45										14	28	54	70	167:21	
27	150	0:45										17	34	56	73	181:21	
27	160	0:45										19	41	56	78	195:21	
27	170	0:45										21	48	55	85	210:21	
27	180	0:45										23	54	59	88	225:21	
27	190	0:45										28	56	64	92	241:21	
30	28	1:30													0	1:30	I37
30	30	1:21													4	5:30	J38
30	35	1:21													16	17:30	J40
30	40	1:21													26	27:30	K42
30	45	1:12												8	28	37:30	K43
30	50	1:12												17	28	46:30	L45
30	55	1:12												25	28	54:30	M47
30	60	1:03											5	28	27	61:30	N49
30	65	1:03											12	28	27	68:30	N50
30	70	1:03											18	28	29	76:30	O52
limit line																	
30	75	1:03											24	28	34	87:30	54
30	80	0:54										1	28	28	40	98:30	55

TABLE A-2M

3:06 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METEPS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
30	90	0:54										11	27	28	50	117:30	58
30	100	0:54										19	27	32	59	138:30	61
30	110	0:54										25	28	41	64	159:30	
33	24	1:39													0	1:39	I36
33	25	1:30													1	2:39	I37
33	30	1:30													15	16:39	J39
33	35	1:21												1	27	29:39	J41
33	40	1:21												12	28	41:39	K44
33	45	1:21												23	28	52:39	L46
limit line																	
33	50	1:12											5	28	28	62:39	48
33	55	1:12											14	28	28	71:39	50
33	60	1:12											23	27	28	79:39	52
33	65	1:03										3	27	28	30	89:39	53
33	70	1:03										10	27	28	37	103:39	55
33	80	1:03										22	28	28	47	126:39	59
33	90	0:54									5	28	27	31	62	154:39	62
36	20	1:48													0	1:48	H36
36	25	1:39													11	12:48	J38
36	30	1:30												3	23	27:48	J41
36	35	1:30												13	28	42:48	K43
36	40	1:21											3	23	28	55:48	L46
limit line																	
36	45	1:21											10	28	28	67:48	48
36	50	1:21											21	28	28	78:48	50
36	55	1:12										4	27	28	28	88:48	52
36	60	1:12										13	27	28	31	100:48	54

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 * TBLP7 VVAL18 (METEPS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRP DES (6)
36	70	1:03									1	28	28	28	44	130:48	58
36	80	1:03									15	28	28	28	65	165:48	62
39	16	1:57													0	1:57	G34
39	20	1:48													5	6:57	I37
39	25	1:39												4	16	21:57	J39
39	30	1:30											2	9	26	38:57	K42
39	35	1:30											6	19	28	54:57	L45
39	40	1:30											13	26	28	68:57	M47
limit line																	
39	45	1:21										6	19	28	27	81:57	50
39	50	1:21										11	26	28	28	94:57	52
39	60	1:12									6	24	28	28	38	125:57	57
39	70	1:12									20	28	28	28	61	166:57	62
42	13	2:06													0	2:06	G33
42	15	1:57													2	4:06	G34
42	20	1:48												3	7	12:06	I37
42	25	1:39											3	7	20	32:06	J41
42	30	1:30										1	7	12	28	50:06	K44
42	35	1:30										4	11	22	28	67:06	M47
limit line																	
42	40	1:30										10	15	28	28	83:06	49
42	45	1:21									3	14	23	27	28	97:06	52
42	50	1:21									9	16	28	28	31	114:06	55
42	60	1:12								4	16	28	28	28	54	160:06	60
42	70	1:12								12	28	28	27	33	76	206:06	
45	11	2:15													0	2:15	F32
45	15	1:57												1	4	7:15	H35

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
45	20	1:48											2	6	9	19:15	J38
45	25	1:39										2	7	7	23	41:15	K42
45	30	1:39										7	7	17	28	61:15	L45
limit line																	
45	35	1:30									4	7	14	25	28	80:15	48
45	40	1:30									6	14	19	28	28	97:15	51
45	45	1:21								1	13	14	26	28	32	116:15	54
45	50	1:21								6	14	21	28	27	43	141:15	57
45	60	1:12							2	14	22	28	28	28	71	195:15	63
45	70	1:12							9	22	28	28	28	45	87	249:15	
46	10	2:18													0	2:18	F32
46	15	2:00												2	5	9:18	H35
46	20	1:51											3	7	10	22:18	J39
46	25	1:42										4	6	8	24	44:18	K42
46	30	1:33									2	7	8	18	28	65:18	M46
limit line																	
46	35	1:33									6	8	14	26	28	84:18	49
46	40	1:24								1	9	13	20	28	28	101:18	52
46	45	1:24								3	14	14	28	28	34	123:18	55
46	50	1:24								10	14	22	28	28	47	151:18	58
46	60	1:15							6	14	24	28	28	31	75	208:18	64
46	70	1:15							13	25	28	27	28	52	90	265:18	
limit line																	
48	9	2:24													0	2:24	31
48	10	2:15													1	3:24	32
48	15	1:57											1	3	5	11:24	36
48	20	1:48										1	5	7	13	28:24	39
48	25	1:48										7	7	9	26	51:24	43

TABLE A-2M

3:08 PM WED., 4 SEPT, 1985 TBLP7 VVAL18 (METERS)

.70 ATA FIXED PO2 IN NITROGEN RATES: DESCENT 20 MPM; ASCENT 20 MPM

DEPTH (MSW)	BTM TIM (M)	TM TO FIRST STOP (M:S)	DECOMPRESSION STOPS (MSW) STOP TIMES (MIN) 39	36	33	30	27	24	21	18	15	12	9	6	3	TOTAL ASCNT TIME (M:S)	RPT GRU DES (6)
48	30	1:39									6	7	10	19	28	72:24	47
48	40	1:30								6	10	14	22	28	32	114:24	53
48	50	1:21							4	13	14	26	27	28	58	172:24	60
limit line																	
51	8	2:33													0	2:33	31
51	10	2:24													3	5:33	32
51	15	2:06											4	3	7	16:33	36
51	20	1:48									1	3	7	7	16	36:33	40
51	25	1:48									6	7	7	11	28	61:33	44
51	30	1:39								5	7	7	13	22	28	84:33	48
51	40	1:30							5	8	13	14	26	28	41	137:33	55
51	50	1:21						2	13	14	16	27	28	33	71	206:33	62

REPETITIVE/MULTI-LEVEL DIVE TABLES

Tables A-3 through A-7 can be used at a depth in FSW or MSW as noted on each table.

TABLE A-3

Surface Interval Credit Table

START																					
A																			78	286	
B																		3	63	155	363
C																	13	58	117	209	417
D																23	65	110	169	261	469
E															33	75	117	162	222	313	522
F														2	44	86	128	170	214	274	366	574
G													12	54	96	138	180	222	266	326	418	626
H												22	64	106	148	190	232	274	319	378	470	678
I											33	75	117	158	200	242	284	326	371	431	522	730
J										1	43	85	127	169	211	253	295	336	378	423	483	575	783
K									11	53	95	137	179	221	263	305	347	389	431	475	535	627	835
L								22	64	106	147	189	231	273	315	357	399	441	483	528	587	679	887
M							32	74	116	158	200	242	284	325	367	409	451	493	535	580	639	731	939
N						42	84	126	168	210	252	294	336	378	420	461	503	545	587	632	692	783	991
O			11	53		95	136	178	220	262	304	346	388	430	472	514	556	598	639	684	744	836	1044
Z		21	63	105		147	189	231	272	314	356	398	440	482	524	566	608	650	692	736	796	888	1096
FINAL		46	45	44		43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
STD AIR			Z		0		N	M		L	K	J		I	H	G	F		E		D	C	B	A

→ CONTROL DEPTH = 0 FSW

TABLE A-4

Shallow Interval Credit Table, 10 FSW (or 3 MSW), for Letter Repetitive Groups.

START																					
A																			18	42	
B																		1	20	42	66
C																	5	22	41	63	87
D																8	24	41	60	81	106
E															11	25	41	58	77	98	123
F														1	13	26	40	56	73	92	114	138
G													3	15	27	40	54	70	87	106	128	152
H												5	16	28	40	53	68	83	100	119	141	165
I											8	18	28	40	52	65	80	95	112	131	153	177
J										9	19	29	40	51	64	77	91	107	124	143	164	189
K									2	11	20	30	40	50	62	74	87	102	117	135	154	175	199
L								4	13	22	31	40	50	61	73	85	98	112	128	145	164	186	210
M							7	15	24	32	41	51	61	72	83	95	109	123	139	156	175	196	221
N						9	17	26	34	43	52	61	72	82	94	106	119	134	149	166	185	207	231
O			2	11		19	28	36	45	53	63	72	82	93	104	117	130	144	160	177	196	217	242
Z		4	13	21		30	38	47	55	64	73	83	93	104	115	127	141	155	170	188	207	228	253
FINAL		46	45	44		43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25
STD AIR			Z		0		N	M		L	K	J		I	H	G	F		E		D	C	B	A

→ CONTROL DEPTH = 10 FSW

TABLE A-5

Shallow Interval Credit Table, 10 FSW (or 3 MSW) for Numerical Repetitive Groups

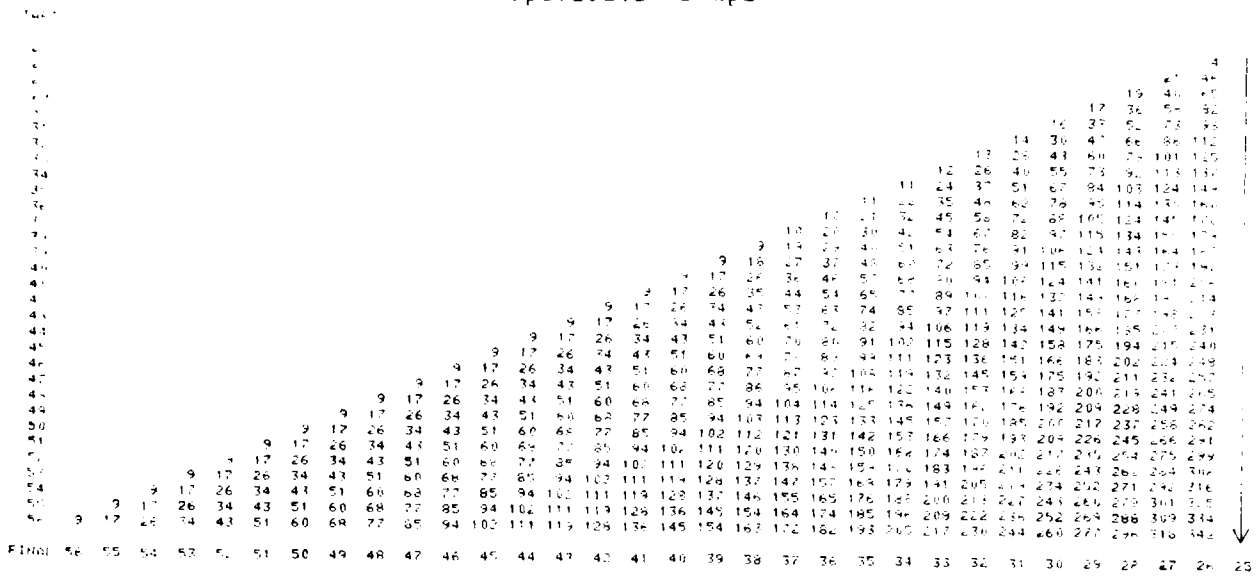


TABLE A-6

Shallow Interval Credit Table, 20 FSW (or 6 MSW), for Numerical Repetitive Groups

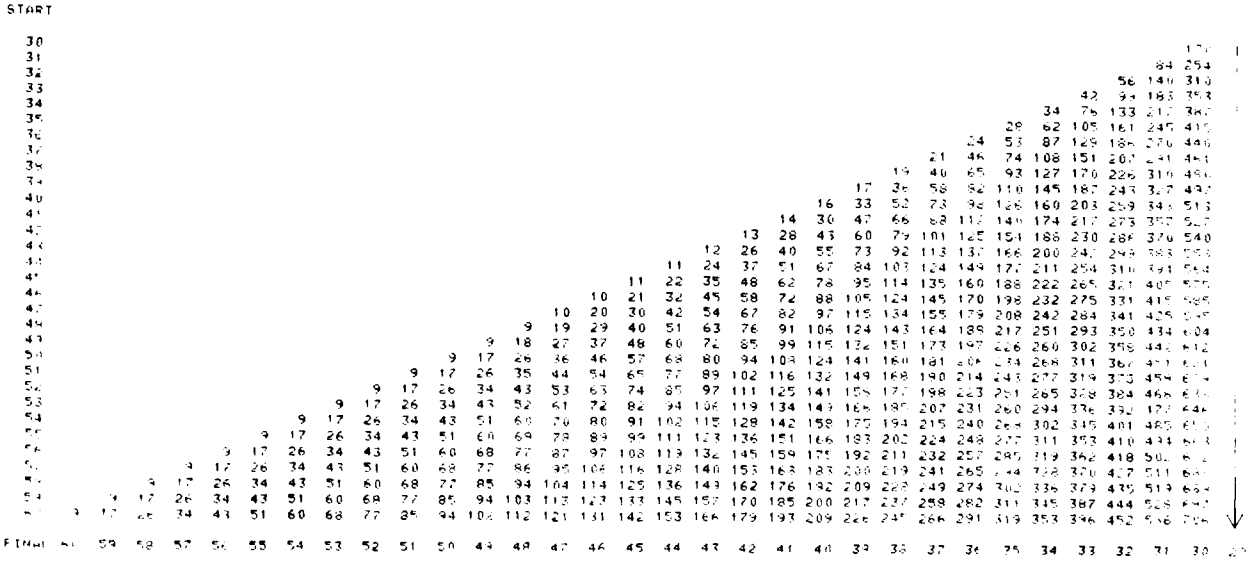


TABLE A-7

Shallow Interval Credit Table, 30 FSW (or 9 MSW), for Numerical Repetitive Groups

START																					
40																				170	
41																			84	254	
42																		56	140	310	
43																	42	99	183	353	
44																34	76	133	217	387	
45															28	62	105	161	245	415	
46														24	53	87	129	186	270	440	
47													21	46	74	108	151	207	291	461	
48												19	40	65	93	127	170	226	310	480	
49											17	36	58	82	110	145	187	243	327	497	
50										16	33	52	73	98	126	160	203	259	343	513	
51									14	30	47	66	88	112	140	174	217	273	357	527	
52								13	28	43	60	79	101	125	154	188	230	286	370	540	
53							12	26	40	55	73	92	113	137	166	200	242	299	383	553	
54						11	24	37	51	67	84	103	124	149	177	211	254	310	394	564	
55					11	22	35	48	62	78	95	114	135	160	188	222	265	321	405	575	
56				10	21	32	45	58	72	88	105	124	145	170	198	232	275	331	415	585	
57			10	20	30	42	54	67	82	97	115	134	155	179	208	242	284	341	425	595	
58		9	19	29	40	51	63	76	91	106	124	143	164	188	217	251	293	350	434	604	
59	9	18	27	37	48	60	72	85	99	115	132	151	173	197	226	260	302	353	442	612	
60	17	26	36	46	57	68	80	94	108	124	141	160	181	206	234	268	311	367	451	621	
FINAL	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP >	STARTING TIME +	TIME AT DEPTH =	FINISH TIME >	FINISHING GROUP >	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____
____	___(___)	______	______	______	____(___)	____/____	______	____

START FINAL SURFACE INTERVAL ____:____

FINAL REPET GROUP ________

____:____

INSTRUCTIONS AND EXAMPLES

FOR

MK 15/16 0.7 ATA PO_2 IN N_2

MULTI-LEVEL/REPETITIVE DIVE TABLES

INSTRUCTIONS AND EXAMPLES

Multi-Level Diving

In the following instructions and examples only dives in feet of seawater are used. Metric diving would use Tables A-1M, A-2M, and A-3 through A-7.

To do multi-level diving, only Tables A-1 and A-2 are needed. Enter the depth of the first dive in the first row of the Depth column on the Repetitive/Multi-Level Dive Worksheet (Table A-8). If the surface interval since the previous air or 0.7 ATA PO_2 in N_2 dive exceeds that shown in the last column of Table A-3, for a given letter group, the dive is "clean" and the Starting Group is 25 and the Starting Time is 0 min. If the surface interval is shorter, find the final repetitive group for the surface interval from Table A-3 and enter as the Starting Group. To find the Starting Time in this case, enter Table A-1 or A-2 at the depth of the dive and find the bottom time associated with the Starting Group. If more than one schedule has the same Starting Group, use the schedule with the shorter bottom time. Enter this bottom time in the Starting Time column. Enter the bottom time of the first dive in the Time at Depth column, and add to the Starting Time to get the Finish Time. The Finishing Group is found using Table A-1 or A-2. Enter these tables at the Depth in the first column of the current row of the worksheet and find the schedule with the numerical repetitive group designator in the Finishing Group column. If the exact numerical group is not found, use the next larger group. If more than one schedule has the same numerical repetitive group, use the schedule with the shorter bottom time. Enter the depth and time of this decompression schedule in the Current Decompression Schedule column and enter the depth in the Control Depth column. The depth of the first stop is entered in the last column of the worksheet.

After spending time at the first depth, the diver may ascend or descend. If ascending, the ascent time need not be taken into account if it was at least 60 FSW/min. If much slower, add the excess time to the Time at Depth of the previous row. When descending, add the descent time to the Time at Depth for the new depth to get a bottom time, no matter what the descent rate. Enter the next depth in the Depth column. The Starting Group is always the Finishing Group from the previous row. The Starting Time is found from Table A-1 or A-2 from the schedule at the Depth having the same numerical group designator as the Starting Group. If more than one schedule has the same Starting Group, use the shorter bottom time as the Starting Time. If the exact numerical group designator cannot be found, use the schedule with the next greater repetitive group designator. Next, enter the actual time spent at this depth in the Time at Depth column (remember to add descent time if the previous depth was shallower) and add to the Starting Time to get the Finish Time. Enter Table A-1 or A-2 for the appropriate Depth/Finish Time combination and write the letter (numerical) group designator for this schedule in the Finishing Group column.

Since the Control Depth is always the deepest depth ever attained during a dive, the depth which should be entered in the Control Depth column will be the larger of the Control Depth from the previous row or the Depth of the

current row. Also, enter the Control Depth to the left of the "/" in the Current Decompression Schedule column. To find the bottom time for the Current Decompression Schedule, find the decompression schedule in Table A-1 or A-2 with the depth equal to the Control Depth, and the bottom time associated with the same numerical repetitive group as in the Finishing Group column.

At this point, if ascent to the surface is done, the Current Decompresson Schedule must be used and all stops taken. If the current Depth is shallower than the first stop of the Current Decompression Schedule, stay at the current Depth for the designated stop time then take all required shallower stops until the next depth is reached. If ascent is 60 FSW/min the ascent time is not considered and no additional time is added to the Time at Depth in computing the next dive segment. If ascent is less than 60 FSW/min, add the missed ascent time to the current stop time. If time at any depth exceeds the prescribed decompression stop, treat this as a new segment of the dive beginning after completing the required stop time.

To add another segment to the dive, enter the next depth in the next row of the Depth column on the worksheet and enter the Finishing Group from the previous row as the Starting Group of the current dive segment. Use Table A-1 or A-2 to find the starting time for the corresponding Depth and Starting Group as previously described and add the Time at Depth to get the Finish Time. Find the decompression schedule from Table A-1 or A-2 corresponding to the Depth/Finish Time of the current row and enter the corresponding repetitive group designator in the Finishing Group column. Enter the larger of the Depth from the current row or the Control Depth from the previous row in the Control Depth column, then find the decompression schedule at the Control Depth with the same numerical repetitive group designator as the Finishing Group. Enter this depth/time combination in the Current Decompression schedule column and use this schedule for ascent to the surface. This process may be continued until the desired dive profile has been completed or the limit line at the current depth is crossed.

After ascent to the surface has been completed, enter the clock time at which the surface was reached as the Start Final Surface Interval time. Enter the letter repetitive group designator from the last current decompression schedule as the Final Repet Group. Finally, go to Table A-3 and find the row for the Final Repet Group and add the time in the last column to the Start Final Surface Interval time to set the Clean Time. The Clean Time is the clock time after which a previous dive need not be considered in determining the decompression requirements for a new dive.

EXAMPLE 1 - Multi-Level Dive: Diver Butler has made no dive in the past 24 hours. He goes to 100 FSW when he stays at depth for for 19 min at which point he ascends to 60 FSW at 60 FSW/min for 30 min. At that point he must go back to 100 FSW for 10 min to retrieve a dropped tool before ascending. What is his final decompression schedule?

Figure A-1 shows the completed worksheet. In row 1, the first depth of 100 FSW is entered and since his surface interval since his last dive was longer than any time in Table A-3, this first dive was a clean dive with a

Starting Group of 25. The Starting Time is 0 min and the Control Depth is 100 FSW. At this point, no further entries need be made until a depth change occurs. After 19 min, ascent to 60 FSW is done. Time at Depth shows the 19 min bottom time plus 2 min descent time from the surface for a finish time of 21 min. From Table A-1, a 100 FSW/21 min dive is a no-decompression dive with a numerical repetitive group designator of 35. This is entered in the Finishing Group and the Starting Group of the next row. The current Decompression Schedule is for a Control Depth of 100 FSW for a bottom time of 21 min. In the second row, the next depth of 60 FSW is entered and using Table A-1 the bottom time corresponding to a numerical group designator of 35 is 43 min which is entered as the Starting Time. Since 60 FSW is shallower than 100 FSW, the Control Depth remains 100 FSW and the Current Decompression Schedule will be at 100 FSW schedule. Again at this point, nothing further needs to be done until a depth change occurs.

After spending 30 min at 60 FSW, a descent is made to 100 FSW. The Time at Depth in the second row will be 30 min which gives a finish time of 73 min. Using Table A-1, a bottom time of 73 min is not found in the 60 FSW row so a 74 min time is used giving a Finishing Group of 41. There is no entry for 100 FSW in the repetitive group 41 column of Table A-1 so Table A-2 is used. In Table A-2 at a depth of 100 FSW, there is no numerical repetitive group of 41 so a group of 42 is used to get the bottom time of 40 min for the Current Decompression Schedule at the 100 FSW Control Depth. The first Stop Depth from the 100/40 schedule is 10 FSW which is entered in the last column.

In row 3, the next depth of 100 FSW is entered along with the Starting Repetitive Group of 41 and a Starting Time of 40 min obtained from Table A-2. The actual time spent at 100 FSW is 10 min but one minute is added because of the descent time from 60 FSW (all times are rounded up to the next minute). This 11 min Time at Depth is added to the 40 min Starting Time to get the 51 min Finish Time which means the repetitive group designator from the 100/55 schedule is used which is M(47). At this point, the dive will decompress on the 100 FSW for 55 min schedule taking a 27 min stop at 20 FSW and a 29 min stop at 10 FSW. The 20 FSW has been entered in the First Stop Depth column. When Diver Butler arrives at the surface it is 13:52 and the final repetitive group is M. From Table A-3, the clean time for a starting group of M is 939 min or 15:39 surface interval which means the diver will be "clean" at 05:31 on the next day. Any dive done before that must start with the diver in the repetitive group found using Table A-2 for the actual surface interval.

If the deepest depth for the total time had been used, the 62 min total time would have meant decompressing on the 100/65 schedule for a total decompression time of 71:40. The multi-level dive procedure saved 14 min of decompression time.

Shallow Interval Diving

Diving where credit for taking a shallow interval is given requires use of one of the Tables A-3 through A-7. The first row of the Multi-level/Repetitive dive worksheet is filled out in the same manner as for a multi-level dive. As a matter of fact, the procedures for a multi-level

FIGURE A-1

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP	STARTING TIME	+ TIME AT DEPTH	= FINISH TIME	FINISHING GROUP	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
① 100	25	0	19+2	21	35	100 / 21	100	0
② 60	35	43	30	73	41	100 / 40	100	10
③ 100	41	40	10+1	51	M 47	100 / 55	100	20
Surface								
						/		
						/		
						/		
						/		
						/		

START FINAL SURFACE INTERVAL 13 : 52 Day 1

CLEAN TIME 05 : 31 Day 2

939 min = 15:39

FINAL REPET GROUP M

dive described earlier may be used until a depth 30 FSW or shallower is reached. If a shallow interval at the surface at 10 FSW is taken, there is never an increase in the repetitive group designator, it will either stay the same or decrease depending on the shallow interval. Table A-3 and A-4 are used after all required decompression stops have been completed and a depth of 0 FSW or 10 FSW has been reached. In these cases the letter designator from the Finishing Group column is brought over to the Starting Group. The depth will be either 0 or 10 FSW, depending on where the depth of the shallow interval is. Under Starting Time put the clock time at which the Shallow Interval begins (hrs:min) and under Time at Depth the actual Shallow Interval in minutes. Use Table A-3 or A-4 to find the final numerical repetitive group for that interval time and enter this in the Finishing Group column. The clock time for the beginning of the next dive is entered in the Finish Time column. There is no current decompression schedule so this is left blank and the Control Depth is the depth of the Shallow Interval if an interval falling to the right of the solid line in Table A-3 or A-4 was taken. If a shorter interval was taken, the Control Depth from the previous dive segment is used. (Entering the clock times for the beginning and end of the shallow interval is for record keeping purposes only and not essential to the procedure. An entry of SI, signifying this is a shallow interval may be made in each of these columns if desired). In the next row, the depth of the next dive is entered under Depth and the Finishing Group Designator is entered as the Starting Group. Table A-1 or A-2 is entered at Depth and the bottom time of the shortest schedule with the Starting Group designator is entered as the Starting Time. The bottom time, which should include descent time, is entered as Time at Depth and added to Starting Time to get the Finish Time. Table A-1 or A-2 is entered for the appropriate Depth/Finish Time schedule and the associated repetitive group designator entered as the Finishing Group. The Control Depth at this point is Depth. (If the shallow interval since the previous dive segment is to the left of the solid line in Table A-3 or A-4, the Control Depth will be the same as the value from the previous dive segment.) The Current Decompression Schedule will be at the Control Depth and the bottom time will be from the schedule in Table A-1 or A-2 with the Finishing Group designator. At this point, decompression to the surface on the Current Decompression Schedule may be done or the diver may proceed to another depth and do a multi-level dive or another shallow interval dive.

EXAMPLE 2 - Repetitive Dive with Surface Interval: After completing the dive shown in Figure A-1, diver Butler spends 135 min at the surface and then makes an 8 min dive to 120 FSW.

The worksheet for this dive is shown in Fig. A-2. In row 1 the Depth is 0 FSW since the shallow interval was to the right of the solid line in Table A-3. The Starting Group is M, which was the Finishing Group from the previous dive shown in Fig. A-1. The clock time for the start of the surface interval is entered under Starting Time, the surface interval of 135 min entered as Time at Depth and the clock time for the beginning of the next dive (end of the surface interval) entered under Finish Time. Table A-3 is used to find Finishing Group. In the row labeled M, a surface interval of 135 min is not found, so the next larger time, 158 min, is used and the final group is 39, which is entered as the finishing group. Since this time is to the right of the solid line, the Control Depth decreases to 0 FSW. There is no Current

FIGURE A-2

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP	>	STARTING TIME	+	TIME AT DEPTH	=	FINISH TIME	>	FINISHING GROUP	>	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
① 0	‹M›		13:52		135		16:07		‹39›		—	0	—
② 120	‹39›		30		8+2		40		L ‹46›		120, 40	120	30
Surface	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		

START FINAL SURFACE INTERVAL 17 : 15 Day 1 FINAL REPET GROUP L

CLEAN TIME 08 : 02 Day 2

(887 min = 14:47)

Decompression Schedule, and the Control Depth is 0. The Finishing Group of 39 is entered as the Starting Group in row 2. The depth of the next dive is entered in the Depth column and Table A-2 is used to find the 120 FSW schedule which has a numerical group designator of 39. The bottom time of this schedule is 30 min which becomes the Starting Time. The 2 min Descent Time is added to the 8 min actually spent at 120 FSW to get a Time at Depth of 10 min. This is added to the Starting Time to get a Finish Time of 40 min. The repetitive group designators for the 120/40 schedule are entered as the Finishing Group. The Control Depth now is 120 FSW and the bottom time at that depth from Table A-2 associated with a numerical group of 46 is 40 min and the first stop is at 30 FSW. So Diver Butler decompresses on a 120/40 schedule, surfacing at 17:15 with a final letter group of L. Table A-3 shows his Clean Time to be 887 min or 14:47 hrs so if his next dive is after 8:02 on the following day, no effects from this dive need be considered.

In Example 2, it would have made no difference if the Shallow Interval Time had been to the left of the solid line in Table A-3 because the new depth was 120 FSW. Since this is deeper than the Control Depth from the previous dive, Diver Butler would still have had 120 FSW as the Control Depth for his next dive. In the next example, the Control Depth does not decrease because the Surface Interval is too short.

EXAMPLE 3 - Multi-Level Dive with Surface Interval: Diver Butler completes the dive in Figure A-1, spends 55 min at the surface then dives to 80 FSW where he spends 25 min.

Figure A-3 shows the completed worksheet. In this case, the 55 min Surface Interval is to the left of the solid line in Table A-3 so the Control Depth is not 0 FSW as in Figure A-2, but is 100 FSW, the Final Control Depth from the previous dive. Table A-3 shows that the Final Group for a 55 min Surface Interval is 41 (go to the next larger time in the table, which is 74 min). From Table A-2, the 80 FSW schedule with a numerical group designator of 41 is the 80/50, so the Starting Time is 50 min. The Descent Time is actually 1 min 20 sec but is rounded up to 2 min and added to the actual time spent at 80 FSW. The Finishing Time is 77 min and the next schedule in the table is 80/80 with a numerical group designator of 48. Since the Control Depth is 100 FSW, the Current Decompression schedule will be the 100 FSW table with a numerical group of 48. Table A-2 shows no table with a numerical group of 48 so the next table is used, the 100/60. The letter group designator is N, which is entered as a Finishing Group Designator and also as the Final Repet Group. Diver Butler should decompress on the 100/60 schedule with the first stop at 30 FSW.

In Example 3, Diver Butler starts out at 80 FSW with a Starting Time of 50 min. Since the limit line at 80 FSW is at the 90 min schedule, Diver Butler could not spend more than 40 min (including descent time) at 80 FSW but would have to decompress at that time.

FIGURE A-3

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP	>	STARTING TIME	+	TIME AT DEPTH	=	FINISH TIME	>	FINISHING GROUP	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
											Previous Dive	
00	⟨M⟩		13:52		55		14:47		⟨41⟩	/	100	—
380	⟨41⟩		50		25+2		77		N ⟨48⟩	100 , 60	100	30
Surface	⟨ ⟩								⟨ ⟩	/		
	⟨ ⟩								⟨ ⟩	/		
	⟨ ⟩								⟨ ⟩	/		
	⟨ ⟩								⟨ ⟩	/		
	⟨ ⟩								⟨ ⟩	/		
	⟨ ⟩								⟨ ⟩	/		

START FINAL SURFACE INTERVAL 16 : 18 Day 1 FINAL REPET GROUP N

CLEAN TIME 08 : 49 Day 2

991 min = 16.31 hrs

EXAMPLE 4 - Repetitive Dive with 10 FSW Shallow Interval: Diver Schwartz has made no dive in the past 24 hrs, he makes a 100 FSW for a 30 min bottom time at which point he ascends to 10 FSW. He stays at 10 FSW for 20 min at which point he descends to 120 FSW for 8 min before beginning decompression. The worksheet for this dive is shown in Fig. A-4.

The first row of the worksheet is filled out as in Example 1 except the bottom time (descent time plus time at depth) in this case is 30 min. The diver is initially on a 100/30 schedule which has a 6 min stop at 10 FSW and which has a letter designator of J. Row 2 shows 10 FSW as the Depth of the shallow interval with the starting group as J. The actual time spent at 10 feet is 20 min but the shallow interval cannot begin until the 6 min obligitory decompression stop has been taken, so the time used to find the finishing group is 20-6 = 14 min. Table A-4 is entered in row J and the next larger shallower interval time from 14 min is 19 min which makes the final repetitive group 37. Since this time is to the left of the solid line, the Control Depth cannot decrease to 10 FSW. At this point the Control Depth is still 100 FSW but once the diver goes deeper to 120 FSW the control depth will increase to that depth. The third line shows the entry for the 120 FSW segment of the dive. The starting group is 37, the finishing group of the previous line. Looking at the 120 FSW schedule in Table A-2, there is no schedule with a numerical repetitive group at 37, so the schedule with the repetitive group of 38 is used which has a bottom time of 25 min. This is added to the actual bottom time of 8 min (6 min at 120 FSW plus 2 min descent time) to get a Finish Time of 33 min. The appropriate schedule from Table A-2 for selecting the Finishing Group is the 120/35 which has repetitive group designators K (43). Since the Control Depth is 120 FSW the Final Decompression Schedule is the 120 FSW schedule having a numerical repetitive group designator of 43 which is the 120/35 schedule. Diver Schwartz decompresses on the 120/35 schedule which has the first stop at 20 FSW and arrives at the surface at 09:17. Table A-3 shows his Clean Time to be a surface interval of 835 min or 13:55 hrs which means the time after which the next dive is not a repetitive dive is 23:12 of the same day.

Shallow intervals may also be taken at depths of 10-30 FSW where the shallow interval begins immediately upon arrival at the stop, rather than after completing the required decompression stop. In these cases, the numerical repetitive group designator is used as the starting group. If there are intervening decompression stops, take all required stops but do not add any ascent time to the bottom time. Use Table A-5, A-6, or A-7 to find the final repetitive group. When using Table A-5 for 10 FSW shallow intervals, the final repetitive group will be the same or less than the starting group, never greater. Also, if the numerical repetitive group at the beginning of the 10 FSW shallower interval is never greater than 56, no matter what the designator from Table A-1 or A-2 is.

In Example 4 above, Table A-5 could have been used with the shallow interval beginning as soon as 10 FSW was reached. The shallow interval would have been 20 min, but to use Table A-5 the numerical group designator from the previous dive segment, which was 38, would be used. In this case the Final Group would have been 36 and the appropriate 120 FSW schedule would be the 120/20 making the Starting Time 20 min and the Finish Time 28 min. Decompression could then be done on the 120/30 schedule. This apparent

FIGURE A-4

NULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP	STARTING TIME	+ TIME AT DEPTH	= FINISH TIME	FINISHING GROUP	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
① 100	‹25›	0	28+2	30	J ‹38›	100 , 30	100	10
② 10	J ‹ ___ ›	SI	20-6=14	S.I.	‹37›	___ , ___	100	—
③ 120	‹37›	25	6+2	33	H ‹43›	120 , 35	120	20
Surface								

START FINAL SURFACE INTERVAL 09 : 17

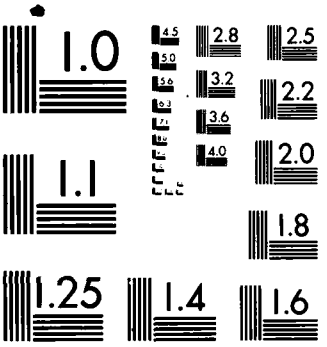
CLEAN TIME 23 : 12

835 min = 13 55

FINAL REPET GROUP H

AD-A161 033 REPETITIVE/MULTI-LEVEL DIVE PROCEDURES AND TABLES FOR CONSTANT 07 ATA OXY (U) NAVY EXPERIMENTAL DIVING UNIT PANAMA CITY FL E D THALMANN SEP 85 NEDU-9-85 2/2

UNCLASSIFIED F/G 6/11 NL



discrepancy is due to the round off errors used in constructing the repetititve dive tables. In this case, it is perfectly alright to use the table which gives the shorter Current Decompression Schedule. However, when using Table A-4, a reduction in Control Depth is never possible, no matter what the time interval. It should also be noted that if the interval at 10 FSW had been 1 min shorter, 19 min, then the Current Decompression schedule would have been the same, whether Table A-3 or A-4 were used to compute the Finishing Group. Usually, Table A-3 will give the shorter Final Decompression Schedule because the letter group designator usually represents a lower 120 min tissue tension than the numerical group. In Example 4, they both happen to be the same, 38 FSW.

When the shallow interval is taken at 20 FSW, the repetitive group will only decrease if the initial group is 30 or greater. At 30 FSW, a decrease in repetitive group will occur only if the initial group is 40 or greater. If the initial repetitive group at 20 FSW is 27, Table A-1 shows that the equivalent bottom time is 154 min, and if any additional time is spent at 20 FSW, the repetitive group designator will increase to 28. However, no matter how long one stays at 20 FSW, the numerical repetitive group designator will not increase beyond 29, and if the initial repetitive group is greater than 29, the final numerical repetitive group cannot decrease below 29. This is because the inspired nitrogen tension at 20 FSW is 29. AT 30 FSW, the final repetitive group approaches 39 for the same reason. Note for Table A-1 that after 423 min at 20 FSW, the repetitive group increases from 28 to 30, whereas it was just pointed out that it should not increase above 29. This is because the times in Table A-1 are computed to a specific letter repetitive group value. At 20 FSW, the numerical group associated with group C is 29 FSW, while at deeper depths it increases to 30. The numerical group designators in Table A-1 are the largest associated with the designated letter group. This inconsistency between Table A-1 and A-6 and A-7 is a result of the compromises made in constructing the tables. The following two examples illustrate how a repetitive group can increase or decrease at 20 or 30 FSW.

EXAMPLE 5 - Repetitive Dive with a 20 FSW Shallow Interval: Diver Knafelc makes a "clean" dive to 150 FSW for 17 min after a 3 min descent. At that point ascent to 20 feet is made where a time of 90 min is spent. At that point decompression to the surface is made.

In Figure A-5, the entries in the first row reflect the 150 FSW initial dive segment. Since the initial dive is "clean" the starting group is 25 and the starting time is 0. The Time at Depth and Finishing Time are both 20 min and the control depth is 150 FSW with a current decompression schedule of 150/20 and a Finishing Group designator of 39. Table A-2 shows that on the 150/20 schedule there is a 2 min stop at 30 FSW, so this stop must be taken during ascent to 20 FSW. Table A-6 shows that for a starting group of 39, spending 90 min at 20 FSW will reduce the group to 35. (Since the exact surface interval is not found in the table, the next larger one of 110 min is used). The control depth is still 150 FSW and consulting Table A-2 the bottom time at 150 FSW which has a numerical group designator of 35 is 15 min. The letter group for this schedule is H. Since the time spent at 20 FSW exceeds

FIGURE A-5

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP		STARTING TIME	+	TIME AT DEPTH	=	FINISH TIME		FINISHING GROUP		CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
① 150		(25)	0		123		20			(39)	150, 20	150	30
② 20		(39)	S.I		90		S.I.		H	(35)	150, 15	150	20
Surface		( )								( )	/		
		( )								( )	/		
		( )								( )	/		
		( )								( )	/		
		( )								( )	/		
		( )								( )	/		

START FINAL SURFACE INTERVAL 11 : 41

CLEAN TIME 22 : 59

678 min = 11:18

FINAL REPET GROUP H

the required sum of the required 2 min 20 FSW stop and the 4 min 10 FSW stop, ascent directly to the surface is possible (remember, the 10 FSW stop may be taken at 20 FSW). As a matter of fact, direct ascent to the surface would have been possible after 17 min at 20 FSW, since the sum of the 20 and 10 FSW stop for the initial 150/20 decompression was 17 min. The only thing gained from the long stay at 20 FSW is reducing the repetitive group designator after surfacing from J to H. This will reduce the starting time for any further dives and reduces the clean times from 783 to 678 min. Note that direct ascent was only possible because the diver was at 20 FSW. If the diver had taken a 30 FSW interval, the required 20 FSW and 10 FSW stop would have to be taken in their entirety. So, in general, time spent at 20 FSW or shallower may be subtracted from required decompression when ascending from that depth directly to the surface.

EXAMPLE 6 - Repetitive Dive with a 30 FSW Shallow Interval: Diver Burwell makes a "clean" dive to 100 FSW where he spends 19 min then ascends to 30 FSW. He stays at that depth for 24 min then descends to 120 FSW for 8 min. At that point he decompresses to the surface.

Figure A-6 shows the dive worksheet for this dive. The first row reflects the initial 100 FSW segment of the dive. When the 2 min descent time is added to the 19 min spent at depth, the resulting 21 min finish time still has the diver within no-decompression limits and the finishing group is 35. In the second row, the 30 FSW shallow interval depth is entered under Depth and the Finishing Group from the previous dive segment entered under Starting Group. Looking at Table A-7, there is no starting repetitive group entry less than 40. This means Table A-1 must be consulted. Looking in Table A-1 under the column headed by the repetitive group designator of 35, the corresponding bottom time at 30 FSW is 211 min, which is entered as the Starting Time. Adding the 24 min actually spent at 30 FSW results for a Finish Time of 235 min. The next greater time in the 30 FSW row of Table A-1 is 273 min, which corresponds to a Finishing Group of H(36). Since the previous Control Depth is deeper than 30 FSW, the Control Depth is still 100 FSW and the Current Decompression Schedule will be a 100 FSW schedule with a numerical group designator of 36. From Table A-1, the corresponding schedule is 100/24 which is still a no-decompression dive. In the last row, the final depth of 120 FSW is entered and the Starting Group is 36, the same as the Finishing Group from the previous dive segment. The 120 FSW schedule with the numerical group designator of 36 is the 120/20 schedule from Table A-2 which gives a Starting Time of 20 min. The descent time from 30 to 120 FSW is added to the Time at Depth of 8 min and this is added to the Starting Time to get a Finishing Time of 30 min. The 120 FSW schedule which has a numerical repetitive group designator of 41 is the 120/30. Since the new depth of 120 FSW is deeper than the previous Control Depth of 100 FSW, the new Control Depth is 120 FSW so the diver will be decompressing on a 120/30 schedule, which will require a 14 min stop at 20 FSW and 29 min stop at 10 FSW. Upon surfacing at 14:22 the diver is in group K and the diver will be "clean" at 01:25 the next morning, 11:03 hrs later.

FIGURE A-6

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP	>	STARTING TIME	+	TIME AT DEPTH	=	FINISH TIME	>	FINISHING GROUP	>	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
① 100	‹25›		0		19+2		21		‹35›		100 / 21	100	0
② 30	‹35›		211		24		235		‹36›		100 / 24	100	0
③ 120	‹36›		20		8+2		30		J ‹41›		120 / 30	120	20
Surface	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		
	‹ ›								‹ ›		/		

START FINAL SURFACE INTERVAL 14:22 Day 1 FINAL REPET GROUP J

CLEAN TIME 01:25 Day 2

>83 min = 11:03

The previous 6 examples illustrate how the multi-level/repetitive dive procedures can be used to find the final decompression schedule for relatively straightforward, simple dives. This last example will illustrate how the procedure can be used on a very long and complex dive. The reader should be thoroughly familiar with all material and examples presented previously in order to fully understand how the final schedule in this example is arrived at.

EXAMPLE 7 - Multi-Level/Repetitive Dive: Diver Curley is testing a new long duration Diver Propulsion Vehicle (DPV) and sets out on a long duration dive. He has made no dives within the previous 24 hrs. He starts out from the surface and goes to 130 FSW where he stays until 20 min have elapsed since leaving the surface. He then ascends to 20 FSW over the next 2 min where he does a 2 hr transit. At that time he excurts downward at 50 FSW/min to 150 FSW where he stays for 10 min, comes back to 100 FSW at 60 FSW/min where he stays for 15 min, then ascends to 10 FSW slowly (at about 5 FSW/min) where he stays for 120 min. He then descends once again to 90 FSW in 3 min where he stays for 29 min before decompressing to the surface.

Figure A-7 shows the completed multi-level/repetitive dive worksheet. The first line reflects the intitial 130 FSW segment. Since Diver Curley started his watch at the surface, the 20 min time at depth already includes descent time. Line 2 shows the 20 FSW shallow interval. Since ascent was done very close to 60 FSW/min, it does not have to be considered. Table A-6 was used to find that the repetitive group designator decreased from 37 to 33 during the 120 min time actually spent at 20 FSW. The control depth is still 130 FSW so the 130 FSW schedule with a repetitive group designator of 33 is the Current Decompression Schedule which is a 130/13 no-decompression schedule. In Line 3, the descent time from 20 to 150 FSW is rounded up to the next minute and is added to the time actually spent at 150 FSW. Table A-1 was used to find the starting time of 11 min and Table A-2 was used to get the numerical repetitive group designator of 42 for a 150/25 schedule. Since the dive depth has now increased, the Control Depth is now 150 FSW, and the Current Decompression Schedule is 150/25 with the first stop at 40 FSW. Line 4 shows the 100 FSW segment and since ascent was at 60 FSW/min, ascent time need not be considered. Table A-2 was used to get the 40 min Starting Time. At this point, the diver knows he wants to ascend slowly but is currently on a 150/25 schedule with a stop at 40 FSW. He also knows his schedule will increase because of time spent at 100 FSW. He begins his ascent and decides to stop at 50 FSW, the first stop of the next longer 150 FSW schedule. He leaves 100 FSW having spent 20 min there and takes 10 min to reach 50 FSW. He should have taken only 1 min 40 sec so his excess ascent time was 8 min 20 sec which is rounded up to 9 min and added to his 15 min at 100 FSW. The diver adds this 24 min to the 40 min starting time, to get the 64 min Finish Time. Table A-2 shows the 100/65 schedule to have a numerical repetitive group designator of 51, and going to the 150 FSW Control Depth schedule, the appropriate Current Decompression Schedule with a repetitive group of 51 is the 150/40. At this point, the diver knows he will have a 7 min 50 FSW stop. During ascent to 10 FSW, the diver takes his stops at 50, 40, 30, and 20 FSW before arriving at 10 FSW. Since his interval at 10 FSW is 90 min, which is longer than the 28 min obligatory stop at 10 FSW, the diver may ascend to the surface any time after spending 28 min at 10 FSW. However, since the 150/40 Current Decompression Schedule is over the limit line, there is no letter designator so the numerical repetitive group must be used in Table A-5 as the

FIGURE A-7

MULTI-LEVEL / REPETITIVE DIVE WORKSHEET

DEPTH	STARTING GROUP	STARTING TIME	+ TIME AT DEPTH	= FINISH TIME	FINISHING GROUP	CURRENT DECOMPRESSION SCHEDULE	CONTROL DEPTH	FIRST STOP DEPTH
① 130	‹25›	0	20	20	‹37›	130 / 20	130	10
② 20	‹37›	S.I	120	S.I	‹33›	130 / 13	130	0
③ 150	‹33›	11	10+3	24	‹42›	150 / 25	150	40
④ 100	‹42›	40	15+9	64	‹51›	150 / 40	150	50
⑤ 10	‹51›	S.I.	120	S.I.	‹38›	150 / 20	150	30
⑥ 90	‹38›	32	29+3	64	‹49›	150 / 35	150	50
Surface	‹ ›				‹ ›	/		
	‹ ›				‹ ›	/		

START FINAL SURFACE INTERVAL 16 : 48 Day 1 FINAL REPET GROUP _____

CLEAN TIME 11 : 14 Day 2

1096 min = 18 26

starting group at 10 FSW. Since Table A-5 is used, no reduction in Control Depth is allowed and the 28 min obligatory stop time is counted as part of the shallow interval. (If the Current Decompression Schedule were above the limit line, the letter group could be used with Table A-3 and the Control Depth reduced to 10 FSW if the interval was to the right of the solid line. In this case the shallow interval would not include the 28 min obligatory stop time.) The repetitive group designator at the end of the 120 min shallow interval is 38 and the Control Depth still 150 FSW. During the final dive segment, according to Table A-1, the diver starts his dive at 90 FSW with a residual nitrogen time of 32 min. The descent time to 90 FSW is added to the 29 min spent at depth for a Finish Time of 64 min which makes the Finishing Group 49 as indicated in the 90/70 decompression schedule. The 150 FSW table with a numerical group of 49 is the 150/35. Diver Curley has 82 min of decompression and surfaces with no letter group designator. This means he must spend the full 18:26 hrs at the surface before he is "clean".

Compatibility With USN Standard Air Tables

The procedures described here may be used even if an air dive has preceded the 0.7 ATA O_2-N_2 dive or if an air dive follows. If an air dive using the USN Standard Air Tables has been done, use the repetitive group designator from the Standard Air Tables to enter Table A-3 and find the beginning numerical group for the N_2-O_2 dive. If an air dive is to follow an N_2O_2 dive, use Table A-3 to find the numerical repetitive group designator at the end of the surface interval. Use the letter group below that numerical group in Table A-3 to find the residual nitrogen time from the Standard Air Residual Nitrogen Timetables. DO NOT USE THE STANDARD AIR SURFACE INTERVAL CREDIT TABLE TO FIND THE FINAL REPETITIVE GROUP FOR AN AIR DIVE FOLLOWING AN 0.7 ATA O_2-N_2 DIVE.

In order to switch from an air breathing mix to a 0.7 ATA O_2-N_2 breathing mix and use the tables presented here, a interval to the right of the solid line in Table A-3 or A-4 must be spent 10 FSW or shallower after all air decompression stops have been taken, including the 10 FSW stop. In order to switch from 0.7 ATA O_2-N_2 to air, again an interval to the right of the solid line in Table A-3 or A-4 must be completed after all required decompression has been taken. Switches between air and 0.7 N_2O_2 at other depths cannot be made using these tables.

END

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